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From the photograph by Mrs. Elliott 1893

Admiral Sir F. Leopold M'Clintock, K.C.B.
D.C.L., LL.D., F.R.S.

The Geographical Journal.

No. 1:

JANUARY, 1908.

VOL. XXXI.

ADMIRAL SIR LEOPOLD M'CLINTOCK, K.C.B.

By Sir CLEMENTS R. MARKHAM, K.C.B.

A GREAT explorer, a great geographer, has passed from among us,

“his conflict past,
and life's long battle won at last.”

There remains for us a great name, a name which should inspire M'Clintock's countrymen to emulate his example, and to cultivate the high qualities which made him famous.

Francis Leopold M'Clintock was born at 1, Seatown Place, Dundalk, on July 8, 1819, and was one of twelve children. He came of a Scottish family settled in county Donegal since the time of Queen Elizabeth. His father, Henry M'Clintock, formerly of the 3rd Dragoon Guards, had charge of the Custom House at Dundalk. He was a younger brother of John M'Clintock, M.P., of Drumcar, father of the first Lord Rathdonnel and of Lieut. William Bunbury M'Clintock, R.N. His wife, the mother of Leopold, was Elizabeth Melesina, daughter of the Venerable Dr. Fleury, D.D., Archdeacon of Waterford.

Leopold, when he was a very small boy, was sent to the Dundalk school under the Rev. John Darley, afterwards Bishop of Meath. His wish to go to sea was rather suddenly gratified. Captain Charles Paget was commissioning the *Samarang* at Portsmouth, and gave his nomination of a first-class volunteer to his first lieutenant, William Bunbury M'Clintock, who at once offered it to his uncle Henry for his young cousin Leopold. The letter arrived on June 20, 1831, when the little boy was not quite twelve years old, 4 feet 6 inches high, and weighing 68 lbs. He was sent off the same evening in charge of Mr. Perkins, a

tide-waiter under his father, going from Dublin to Bristol, and thence by coach to Portsmouth. The captain and every one on board were extremely kind to "little Paddy," as they called him, and Mr. Perkins took leave of him with the following injunction: "Good-bye, Master Leopold; never turn your back on the enemy while you've a face to face him with." The first lieutenant, when he went to look for his little cousin, said he was so small, it was like looking for a flea in a blanket.

The *Samarang's* commission was a very happy one. She was a 28-gun frigate. In those days the South American station included both sides. At one time she was in the Gulf of California, when Captain Paget used to take little M'Clintock on shooting excursions, sometimes for two or three days, and gave him a pea-rifle. In another part of the commission she was a good deal at Bahia and on the Brazilian coast, where the little boy learnt to swim. The *Samarang* was paid off in January, 1835, when the captain was twenty-six, having been promoted to that rank at the early age of twenty-three. He was a son of Admiral the Hon. Sir Charles Paget, K.C.B., and afterwards became M'Clintock's brother-in-law.

M'Clintock's next ship was the *Carron* steamer, employed in surveying, chiefly round the Isle of Man. It was a very rough and arduous time under an exceptionally unpleasant commander, but the *Carron* was paid off in November, 1835. M'Clintock then joined the *Hercules* (74) in the Channel squadron, under Captains Maurice Berkeley and Toup Nicholas. In 1837 he was transferred to the *Crocodile*, on the North American station, under Captain Polkinghorne. M'Clintock then saw a good deal of the ports on the Spanish main—especially Santa Marta; and after some time, the *Crocodile*, then under Captain (afterwards Sir Alexander) Milne, was sent to the coast of Newfoundland, where the young midshipman passed some time very pleasantly, shooting and fishing. He was also at Quebec. He passed for seamanship at Bermuda, and soon afterwards the *Crocodile* captured a slaver, the *Mercedita*, off the south coast of Cuba. M'Clintock was one of the prize crew to take her to Havanna, where she was condemned by the Prize Court. His share of the prize money was only £6.

In the end of 1841 M'Clintock was appointed to the *Excellent*, then commanded by Sir Thomas Hastings, to pass for a lieutenant, remaining there until 1843. He got a first class in steam machinery and practical gunnery, and a second class in mathematics.

Having completed his examination for a lieutenant, he was appointed to the *Gorgon*, a paddle-wheel steamer commanded by Captain Charles Hotham, and proceeded to the Brazilian station. At that time M'Clintock's father died, and his mother went to live in Dublin. On May 1, 1844, when at anchor off Montevideo, the *Gorgon* was driven on shore, high up on the beach, during a violent *pampero*. Commodore Purvis and others said it was impossible that she could ever float again. But

with Charlie Hotham there was no such word as "impossible." She was on the beach until October 13. Through Hotham's seamanlike skill, ably seconded by his officers and crew, she was successfully floated off. An account of this great feat in seamanship, "The Recovery of the *Gorgon*," was written by one of the junior lieutenants, the late Admiral Sir Cooper Key.

In 1845 Sir Charles Hotham presented M'Clintock with a commission as acting lieutenant, which had been placed at his disposal by Commodore Purvis. He was appointed to the *Frolic*, a sailing brig (sixteen guns), Captain Cospatrick Baillie Hamilton, and joined her, as third lieutenant, in the river Plate, when on her way to the Pacific. On October 2, 1845, the *Frolic* arrived at Honolulu and went into the inner harbour. The present writer was then a naval cadet in the flagship *Collingwood*, and to him it was a memorable date, for on that day he made M'Clintock's acquaintance, leading to a friendship which endured for sixty-two years. The *Frolic* was with us again at Mazatlan, and for more than a year she was up the Gulf of California, smuggling freight at Guaymas, while the officers were shooting deer. There were changes during the commission, and M'Clintock brought the beautiful little brig home, as first lieutenant, in June, 1847.

After some months at home with his mother in Dublin, M'Clintock went to study at the Royal Naval College at Portsmouth on half-pay. But in the early spring of 1848, his friend, Captain William Smyth, who was first lieutenant with Sir George Back in the *Terror*, recommended him to Sir James Ross, who was fitting out an Arctic expedition for the search of Sir John Franklin's ships. He was appointed second lieutenant of the *Enterprise*, M'Clure being first lieutenant. This was the turning-point of M'Clintock's life. It was his opportunity, and he seized it. Ross was an officer of quite unrivalled Arctic experience, having served in six previous expeditions, and under him M'Clintock received his training. The year 1848 was an exceptionally close year, and the expedition was obliged to winter in Port Leopold, at the north-eastern extremity of North Somerset. Sir James Ross, accompanied by M'Clintock, undertook the chief sledge journey, when, by great efforts, a distance out and home of 500 miles was accomplished in forty days. It was a period of intense labour, constant exposure, and insufficient food, and out of twelve picked men five were completely knocked up. Nothing approaching to this had ever been done before. M'Clintock now knew all that Sir James Ross knew, and a great deal more. He saw, with the eye of genius, the numerous improvements which would raise Arctic sledge travelling to a great agency in the work of exploration. He spent the winter of 1849-50 experimenting on the best form of cooking-gear and of fuel, resulting in the almost perfect travelling equipment of 1851. He had the advice and assistance of Prof. Houghton.

The next expedition consisted of two sailing ships, the *Resolute*, Captain Austin, commanding the expedition, and the *Assistance*, Captain Ommanney; and the two sharp-bowed screw steamers, the *Pioneer*, Lieut. Sherard Osborn, and *Intrepid*, Lieut. Cator. The first lieutenant of the *Assistance* was M'Clintock, amongst his messmates being Lieut. Mecham, second only to M'Clintock, Dr. Donnet, Dr. Ede, Vesey Hamilton, and the present writer, the last three still living.

The year 1850, like 1848, was a close ice-encumbered year, and the expedition was obliged to winter in the pack between Cornwallis and Griffith islands. M'Clintock had already thought out many improvements on the system of Sir James Ross, especially the prolonging of the extended journeys by depôts. Captain Austin had wisely entrusted him with the preparations for sledge-travelling, and he had resolved upon autumn travelling for laying out depôts. It was the first time that anything of the kind had been attempted. In giving M'Clintock his orders on September 29, 1850, Captain Austin entered into no details, but relied upon his officer's experience, prudence, and zeal, only reminding him that the season was fast closing. M'Clintock started on October 2, established a depôt of provisions about 30 miles to the westward, and returned on the 9th.

Preparations for the winter were then commenced. M'Clintock was in his 31st year. He was short and wiry, with a lithe active body capable of great endurance. He had a turn for mechanics, and was gifted with inventive talent amounting to genius. He was a silent man, but interested in the conversations of others, and with a sense of humour. Without taking a leading part in the various amusements, he lent his active help, and occasionally contributed to our newspaper. He was an excellent messmate, and quite unrivalled as an Arctic first lieutenant. The *Assistance* was the happiest, the healthiest, the cleanest, the driest, and the most efficient ship that ever wintered in the Arctic Regions.

Throughout the winter, and especially during March when the crews were daily exercised with their sledges, M'Clintock devoted himself to the elaboration of a great scheme of search by sledge travelling. It was due to his judicious arrangements and incessant care that the men emerged from the winter strong, healthy, and full of zeal. The construction of the sledges, tents, and cooking apparatus received the most anxious attention, as well as the clothing and scale of diet, and every article to be taken was carefully weighed and its necessity considered. The plan of search was on a larger scale than has ever been attempted before or since. There were to be as many as six extended parties going in different directions, each with its depôt party, and every three with an auxiliary party. On April 15, Captain Austin delivered a speech to the assembled sledge crews off the north-west cliff of Griffith island, and they started on their destined journeys. It was a memorable scene, the subject of a picture by W. W. May.

M'Clintock's sledge was named the "Perseverance," his motto "Persevere to the end," his flag *argent, a cross azure*. His destination was the western extreme of Melville island, which he reached on May 28. His weights at starting were 417 lbs. constant, 822 provisions, or 206 per man at starting, reduced 20 lbs. each day. M'Clintock helped the men in dragging when he was not wanted as a guide. They were devoted to him. Returning on July 4, M'Clintock and his sledge crew had been absent eighty days, and had travelled over 820 stat. miles at a mean daily rate of $10\frac{1}{2}$ miles. Reporting on the sledge crew, he wrote, "I cannot conclude this account of a journey of eighty days without expressing the satisfaction the men have given me, whose labours have enabled me to fulfil my instructions. Their ever-cheerful behaviour, untiring perseverance, and patient, enduring spirit under many severe trials and privations, excited my warmest admiration." Their names deserve a place in a memoir of their well-loved chief—

James Wilkie (petty officer, 34).

James Dawson (A.B., 23).

John Salmon (A.B., 24).

Thomas Wood (R.M., 29).

James Hoyle (A.B., 25).

Robert Urquhart (R.M. 28).

Finer fellows never stepped. Their average age was 27. They all returned in perfect health. In this journey M'Clintock more than doubled his former record; and all the *Assistance* sledges fulfilled their instructions to the letter, and returned without an accident. The work of Austin's expedition was well conceived and brilliantly executed. M'Clintock was promoted to the rank of commander.

In the next search expedition two vessels, the *Resolute* and steam tender *Intrepid*, made their way to Melville island in a comparatively clear season and wintered there. M'Clintock commanded the *Intrepid*, and Meham, who was closely following in his footsteps, was first lieutenant of the *Resolute*—Vesey Hamilton was third lieutenant, the three leaders of extended parties in 1853, with the traditions and experience of the old *Assistance*. McDougall, the historian of the *Resolute's* voyage, was also in the former expedition. On his return in 1851 M'Clintock had again devoted his time to the study of sledge-travelling problems, especially with regard to the cooking apparatus and economy of fuel. He was resolved to excel his wonderful journey of 1851, for he had brought the system to still greater perfection. In the autumn travelling of 1852 he was away laying out a dépôt for forty days, and covered 225 miles. His spring journey of 1853 was the most wonderful on record. His sledge was named "Star of the North," his motto "Lead thou us on," his flag *azure, a star argent*. He discovered the northern half of Prince Patrick Land and the west coast of Melville island. His disciples, Meham and Vesey Hamilton, discovered the southern half of Prince Patrick Land and the northern extreme of Melville island. M'Clintock was away from the ship 105 days, and

travelled over 1328 miles at a daily rate of $12\frac{1}{2}$ miles. Meham was away 94 days, and went over 1163 miles. Under exceptionally favourable circumstances in 1854, Meham covered 1336 miles at the rate of 16 miles a day on the outward, and $20\frac{1}{2}$ miles a day on the homeward journey. These journeys, without dogs, have never been approached since, and probably never will be. M'Clintock became the first of Arctic travellers, and continued to be the first and greatest until his death fifty-four years afterwards.

On his return, in the autumn of 1854, M'Clintock was promoted to the rank of post-captain. The work of the officers and men employed in the search for the Franklin Expedition is a very glorious record. It was an arduous service, but it was a labour of love, and it was illustrated and made of permanent value by the genius of M'Clintock. He wrote his "Reminiscences of Arctic Ice Travel" for the *Journal of the Dublin Society* in 1857.

At last the right direction for the search became certain through the discovery of relics in the possession of Eskimos. It was a direction which the Admiralty had overlooked. The expedition should have been sought for along the shores of King William island. When this became known, the Admiralty declined to follow up the trail—declined to ascertain the fate of the gallant officers and men they had sent to their deaths. Then it was that Lady Franklin nobly came forward, and, since the Government rejected her appeal, she resolved to spend the remains of her fortune to do the work of the Admiralty. From the first she had spent money lavishly, and had sent two expeditions in the right direction in 1850 and 1851, but they were inefficiently commanded.

This time Lady Franklin was more fortunate. M'Clintock accepted the command of her expedition. Nearly the whole cost was defrayed by her, and among the other subscribers were six relations of Franklin's officers and ten old Arctic shipmates of M'Clintock's. Lady Franklin's letter and M'Clintock's acceptance were on April 18, 1857; and he obtained leave of absence from the Admiralty. The screw-yacht *Fox* of 177 tons was purchased for £2000, and fitted out at Aberdeen, and on July 2 she passed through the Pentland firth.

The officers were Lieut. Hobson, R.N., who had served in the ice on board the *Plover*; Allen Young, a youthful master mariner, who also subscribed £500 to the expedition; and Dr. Walker, the surgeon. M'Clintock took a team of dogs this time, with Carl Petersen, the Danish Eskimo interpreter. There were twenty-one other hands, twenty-six souls all told, including two Eskimos from Greenland. Old Harvey and two others were in the Austin Expedition.

In passing up the coast of Greenland, M'Clintock was able to make a collection of the Atanekerdluk fossil flora, and thus did an important service to geology. The plant named by Prof. Heer *Macclintochia* is an entirely new genus. On entering Melville bay, it was found that

1857 was a very close ice year, and the *Fox* had the misfortune to be beset in the middle pack of Baffin's bay. She was drifted southwards all through the winter of 1857-58. The little vessel was released from the ice under circumstances of great peril. It was blowing a gale, with huge masses of ice plunging and grinding around her. But M'Clintock had no thought of seeking a port for supplies or refreshment. At once he turned her head to the north and renewed the battle. His indomitable pluck was rewarded, and he reached Beechey island in good time, in the season of 1858.

The illustrious explorer was now on the scene of his marvellous victories over nature. He proceeded down Peel sound, between North Somerset and Prince of Wales Land, but was stopped by an ice-barrier right across on August 17. Nothing daunted, he turned and proceeded down Prince Regent's inlet, very nearly succeeding in passing through Bellot strait. He wintered at Port Kennedy near the eastern entrance of the strait.

In February, 1859, he left the *Fox* to establish dépôts for his spring journey. On this occasion he met some Eskimos, got some valuable information, and obtained several Franklin relics. On April 2 he again started. Passing down the channel on the east side of King William island, he again met Eskimos, who told him about the destruction of one of Franklin's ships, and bartered many relics. He then examined Montreal island, and returned after completing the circuit of King William island. He found the skeleton with its relics 9 miles south of Cape Herschel, proving that Franklin's expedition had discovered the North-West Passage. He came to the boat, with two skeletons, and made a minute inventory of its contents, as well as of the relics at Point Victory, including Graham Gore's record with the marginal additions by Captain Fitzjames, which told him the sad story. Hobson had previously visited the cairns, having been sent by another route, in order that, if anything was found, he might have the credit.

To M'Clintock is due the final revelation of the fate of Franklin and his gallant companions, so long obscured, and only made possible by the pious self-denial of Lady Franklin. M'Clintock had prepared himself for this crowning achievement during ten years of most honourable and arduous service. With the noble expedition of which Franklin was the head, and Fitzjames the moving spirit, is for ever and indissolubly connected the illustrious name of Sir Leopold M'Clintock.

The distance accomplished by M'Clintock when he discovered the fate of Franklin, from leaving the *Fox* to his return, was 1079 stat. miles, but adding all his journeys together in 1859, it was 1542 miles. His final conclusion was that one sledge party could take sixty days' food, and travel 600 miles, not more, without dépôts. With Sir James Ross they only managed thirty days, in Austin's expedition forty days,

in the third expedition about fifty days. In a very long journey, his opinion was that men would beat dogs.

The engines of the *Fox* had been partly taken to pieces for the winter, and the engineer had died. M'Clintock's skill and mechanical knowledge enabled him to make them fit for work again with his own hands. Allen Young explored 380 miles of new coast-line, while that discovered by M'Clintock and Hobson amounted to 420, a total of 928 stat. miles of new coast. The *Fox* arrived in England on September 20, 1859. M'Clintock had now served during ten Arctic navigable seasons, and gone through the ordeal of six Arctic winters. He was to serve still another Arctic navigable season.

M'Clintock and his companions had an enthusiastic reception. What touched the great explorer more than anything else was the presentation to him of a gold chronometer by the officers and men of the *Fox*. "As long as I live," he wrote, "it will remind me of that perfect harmony, that mutual esteem, and goodwill which made our ship's company a happy little community, and contributed materially to the success of the expedition." On October 5, 1859, as many as twenty-five old Arctic friends entertained M'Clintock and his officers at dinner at the Thatched House, with Captain Austin in the chair. The Admiralty allowed his time in the *Fox* to count. He received the honour of knighthood; the freedom of the City of London and of the Grocers' Company; and honorary degrees of the Universities of Oxford, Cambridge, and Dublin. In 1860 he received the Gold Medal of the Royal Geographical Society, and was elected a Fellow, and in 1865 he was elected a Fellow of the Royal Society. He read his account of the work of the *Fox* at a crowded meeting of the Geographical Society on November 14, 1859.

Sir Leopold's first appointment, after his return, was to H.M.S. *Bulldog* (paddle steamer, 500 H.P., 1124 tons), sent in compliance with a request from the promoters of the North Atlantic Telegraph Route, to take a line of deep-sea soundings from the Faroe islands to Labrador. His first lieutenant was Charles Parry, a younger son of Sir Edward. Dr. Wallich was the naturalist. Leaving Stornaway on July 1, 1860, M'Clintock proceeded to Westmanshaven, in the Faroe islands, whence he ran a line of deep-sea soundings, by Reikavik in Iceland to a point 25 miles from the east coast of Greenland, a nearer approach being barred by closely packed ice. He met with heavy gales and much ice off Cape Farewell, reaching Godthaab, in Greenland, on August 7, having encountered furious gales all through the previous week. M'Clintock then ran a line of deep-sea soundings from Cape Farewell to Hamilton inlet, in Labrador, which place he reached on August 24. The greatest depth was 2032 fathoms. At Hamilton inlet he met Mr. Donald Smith, the future Lord Strathcona, and they formed a friendship which lasted through life. Recrossing to Greenland, M'Clintock made plans of Godthaab and Julianshaab. He then

took a line of deep-sea soundings from the east coast of Greenland, getting within 4 miles of the shore. But that night there was a storm from the north-east, lasting three days. The *Bulldog* had to lie to under bare poles, drifting southwards. "I could not have conceived so much calmness to have been the property of only one man," wrote Charles Parry. "In the greatest difficulties his face would not alter a muscle. Steady watchfulness and a quick, decided order, though in a low tone; no outward show of anxiety; no nervous irritability, no unnecessary noise ever betokened anxiety, though in his own quiet way, to me he has let out how deeply anxious he was on several occasions. And well he might have been! No one could have passed the same time with him, in similar situations, without gaining confidence in him week by week, until the pinnacle of confidence that man can place in man has been reached." Reikavik was reached on October 19. The line of soundings was carried on to Rockall bank on November 8, and finally the *Bulldog* put into Killibegs, on the coast of Donegal, later in November. This was an important but very arduous service, well performed.

Sir Leopold was next appointed to H.M.S. *Doris* in the Mediterranean. The present writer has very pleasant recollections of a week passed at Malta with his old messmate in April, 1861, when he was waiting for the *Doris*. He had known M'Clintock for many years, but he never before knew of his fondness and very considerable knowledge of wild flowers, or of the interest he felt in antiquities which he showed during a visit to Hagiar Chem and in subsequent interviews with old Signor Vassali at the Valetta library. The *Doris* acted as escort to the Prince of Wales (the present King) when the late Emperor and the Empress Frederick went with him on a visit to the Holy Land. Sir Leopold's next ship was H.M.S. *Aurora*; in her he witnessed the naval action between the Danish and Austrian squadrons off Heligoland, his presence preventing any possible international complication. The *Aurora* afterwards went to the West Indies, and from her Sir Leopold was transferred in September, 1865, to Jamaica as commodore, with his broad pennant on board the *Aboukir*, where he continued to serve until 1868. In that year he became a naval aide-de-camp to the Queen.

Soon after his return home M'Clintock was put forward by the Carlton Club to contest the borough of Drogheda in the Conservative interest, and though he did not succeed, he got something very much better than a seat in Parliament. One of his supporters was Mr. Dunlop of Monasterboice House, near Drogheda, who invited M'Clintock to pay him a visit. There he made the acquaintance of Mr. Dunlop's daughter.

On October 12, 1870, Sir Leopold M'Clintock was married to Annette Elizabeth, daughter of R. F. Dunlop, Esq., of Monasterboice House, and of Anna, daughter of Viscount Ferraud and of Viscountess Massereene in her own right. In the following year he came on the Council of our Society, and continued to serve, off and on, as Councillor

or Vice-President until 1903. From 1872 to 1876 he was Admiral Superintendent of Portsmouth Dockyard, and fitted out the *Alert* and *Discovery* for the Arctic Expedition of 1875-76.

Sir Leopold had completed his work, 'The Voyage of the *Fox* in the Arctic Seas,' in 1859, before he joined the *Doria*. This narrative of the discovery of the fate of Sir John Franklin and his companions, with a preface by Sir Roderick Murchison, is a perfect model of what such a book should be, and shows the character of the author in every page—his modesty, his total unconsciousness of the greatness of his achievement, his simple dignity and straightforwardness. It is a plain narrative admirably told, and is deeply interesting. It will be a classic, among the annals of British enterprise and discovery, for all time. Its value is enhanced by the appendix, containing a geological account of the Arctic archipelago, and a paper on its tidal streams by Prof. Haughton. The fourth edition appeared in 1875, and the fifth in 1881, which has been stereotyped by Mr. Murray.

Sir Leopold M'Clintock became a Vice-Admiral on August 5, 1877, and was appointed Commander-in-Chief of the West Indian and North American Station in 1879, with his flag on board H.M.S. *Northampton*. The present Admiral of the Fleet, Sir John Fisher, was his flag-captain, Admirals Holland and Fawkes were the commanders, and among the other officers was the torpedo lieutenant, an old Arctic officer of 1875-76, the present Admiral George Le C. Egerton. It was a happy and prosperous commission from 1879 to 1882.

On his return, M'Clintock was chosen an Elder Brother of the Trinity House, and at once became one of the most useful and active members of that important corporation, continuing to hold the post, so that practically he died in harness. In 1891 he was created a Knight Commander of the Bath.

Sir Leopold took a very active interest in the recent Antarctic Expedition. It was on April 7, 1899, that Sir Leopold M'Clintock and the present writer had the interview with Mr. W. E. Smith, C.B., of the Controller's Department at the Admiralty, and discussed with him the outline of what they desired as regards a ship for Antarctic work. This meeting constituted the inception of the design of the *Discovery*. A Ship Committee was afterwards formed, of which Sir Leopold was the principal and most active member. When there was opposition to the ship being allowed to winter in the Antarctic Regions, a very striking speech from Sir Leopold practically put an end to the trouble, thus ensuring the success of the expedition. He contributed a very interesting and useful paper on Arctic sledge travelling to the 'Antarctic Manual.' He felt a strong sympathy for the explorers in the south, and, anxious for the interests of Captain Scott on his return, he sent to the Admiralty a copy of the letter giving him his time in the *Fox* in 1859 as a reminder, Scott's being exactly a parallel case.

Sir Leopold took a keen interest in charitable works, chiefly on behalf of seafaring men. For many years he was a Trustee for Miss Weston. He was Chairman of the Royal Alfred Aged Merchant Seamen's Institution, and President of the Royal Naval Scripture Readers' Society.

As old age advanced, Sir Leopold faced the illnesses which accompany it with patience and fortitude. He was very happy in his family relations. A sympathetic and devoted wife was his constant companion, and he had five children—three sons and two daughters. Of his sons it can justly be said, "Truly ye come of the blood."

At last the fiftieth anniversary of the sailing of the *Fox* came round. A letter was addressed to Sir Leopold, on the part of the Council of the Royal Geographical Society, to show him how fully his great merits as an explorer, and his very distinguished services, were still remembered and appreciated. The letter was dated June 30, 1907, and was signed by the President and by two of M'Clintock's old messmates, Markham and Allen Young. In his reply the great explorer testified to the loyalty with which he was supported by those associated with him or under his command. "It is most touching," he concluded, "to find that one is still remembered after so long a time as half a century."

Sir Leopold M'Clintock caught a chill, which ended fatally, and he passed away without pain on November 17, 1907, at the age of eighty-eight. There was a great assembly of mourners on the 22nd. The King was represented by Captain Walker, R.N., the Prince of Wales by Sir C. Cust. The Deputy-Master of the Trinity House and several old colleagues were present, and the Royal Geographical Society was represented by the President and Secretary.

Many of M'Clintock's old messmates and shipmates were there to show respect and veneration for his memory.

The Austin Expedition was represented by Vesey Hamilton and Clements Markham, by the daughter of Captain Austin, the son of Captain Ommanney, and a grandson of Dr. Donnet, the surgeon of the *Assistance*. The third expedition was represented by Vesey Hamilton and George Nares; the *Fox* by Allen Young.

Of a later polar generation were present, Nares, Albert Markham, Parr, and Egerton of the 1875 expedition; Scott, of the Antarctic Expedition; and Fridtjof Nansen, second only to M'Clintock. The two grandsons of Sir John Franklin were also there, Dr. Willingham Gell and Mr. Philip L. Gell. Of Sir Leopold's old flagship *Northampton* were present, Admiral of the Fleet Sir John Fisher, and Admirals Holland, Riddell, and Egerton. A very touching memory of the *Fox* came from Copenhagen—a wreath from the directors of the Royal Greenland Company.

Sir Leopold M'Clintock was reticent, and would have disliked long panegyric. His life-story speaks for itself, and needs none.

AN EXPLORATION OF THE NUN KUN MOUNTAIN GROUP AND ITS GLACIERS.*

By WILLIAM HUNTER WORKMAN, M.A., M.D., F.R.G.S.

THE Nun Kun mountain group is situated in Suru, Kashmir, between $33^{\circ} 55'$ and $34^{\circ} 6'$ lat. N., and $76^{\circ} 2'$ and $76^{\circ} 13'$ long. E. The massif to which this name is applied is comparatively small and compact, standing by itself in the midst of a network of mountains, occupying practically a square with a side of 11 miles. Two parallel spurs of the same fold, connected with the Nun Kun by narrow ridges, extend west to $75^{\circ} 53'$ long. E., enclosing a glacier 8 miles long. If the mountains forming the farther barriers of the glaciers of the group be included, the area would be considerably greater.

The highest central portion is guarded on all sides by a multitude of ragged precipitous spurs or buttresses, which run down from it to the surrounding valleys, the walls of which they help to form. On the north they overhang the Suru river in the Rangdum valley, where for 8 miles, with the opposite mountains, they enclose a gorge through which it flows. The summits of these external buttresses are mostly pointed or serrated, and attain heights of 18,000 to 20,000 feet.

The central part of the massif rises 2000 to 4000 feet, not only above its own lesser peaks, but above all others for scores of miles around, the nearest peak that exceeds it in height being Nanga Parbat, 120 miles north-west. East, west, and south, none of the vast multitude of mountains which it overlooks approach it in height. It stands alone, an elevated island of rock and ice, towering bold and sharp from an ocean of surrounding peaks. Although situated in a fairly well-known region, the valleys around it having for years been visited by sportsmen and somewhat by travellers, its height and its inaccessibility have rendered its upper parts hitherto secure from intrusion.

Sportsmen have occasionally entered the Shafat nala, the easiest avenue of approach, one having camped for some days in 1905 at the site of our base camp, 4 miles above the tongue of the Shafat glacier. In 1902 the Rev. C. E. Barton and Dr. A. Neve paid it a brief visit. They camped for a night near the same point, at an altitude of 14,900 feet, and the next day went up the Shafat glacier to a height estimated by them at about 18,000 feet, returning to a lower camp the same day. In 1903, Mr. Sillem, a Dutch traveller, visited the Shafat glacier. He is reported by Dr. Neve to have reached a height on it of 21,000 feet, but what he is said to have seen is rather indefinitely stated, and does not correspond to the topographical features at that height.

The object of the expedition of Mrs. F. Bullock Workman and myself in 1906 was the more thorough exploration of this region, particularly of

* Read at the Royal Geographical Society, November 25, 1907. Map, p. 182.

the upper unvisited portions. The chief village of the several composing what is called Suru, on the Suru river, three marches south of Kargil on the Leh route, and twelve from Srinagar, was selected as our base, this being the nearest village with a lambardar to the Nun Kun. The crops having failed the two preceding seasons in Suru and Ladakh, no supplies were obtainable there, so we were obliged to forward from Srinagar not only all supplies for our party, but also some 16,000 lbs. of grain for our coolies, to transport which required 243 coolies and 60 ponies. On June 24 we reached Suru, accompanied by the guide, Cyprien Savoye, six Italian porters, and five servants.

Just south of Suru, the Suru valley, which up to this point runs south from Kargil, makes a wide bend around the extremity of a high spur, and from Purkutse, the last village where any cultivation is seen, stretches east for 23 miles, under the name of the Upper Surn or Rangdum valley. It resembles Ladakh valleys, being mostly desert with some scanty vegetation. It cannot boast of a single tree, but the swampy land along the river is covered with bush-growth from 2 to 6 feet high. For 8 miles from Purkutse it consists of a gorge just wide enough for the passage of the here turbulent Suru river, directly over which, on the south, rise the frowning spires of the Nun Kun massif, 11,500 feet above, sending down a number of short glaciers, which do not reach the valley-bed, and a larger one, the Ganri, later to be described. It then opens out with an average width of about 1 mile to its end, where it expands into an amphitheatre, into which four valleys open.

On July 3 we reached Gulmatunga, one march above Purkutse, the site of a deserted village, on the north side of the unbridged Suru river, opposite which the Shafat nala, which was our first objective, enters the Rangdum. To reach this it was necessary to cross the river, which early in July is usually fordable at this point, but we found the water so high that the only way to get over was by swimming, as impossible a feat for our loaded caravan as flying would have been. The weather during the latter half of June had been fine and unusually warm. Since leaving Dras, at elevations from 10,000 to 12,000 feet, we had marched in such sun-maxima as 191°, 199°, 203°, 196°, 200°, 206°, 204·5°, and 205° Fahr. The great heat had melted the snow on the glaciers rapidly, and we had found all glacier-fed streams on our route greatly swollen and turbid, some of them being impassable after twelve o'clock. The Suru river was no exception. Its volume was much increased, and its mud-laden water of a dark slate colour. We camped, hoping to get across early in the morning, but the water did not fall sufficiently to make the river fordable. We were therefore obliged to follow it up for 16 miles to the hamlet of Tazi Tonzas, where it divides into several branches. Here, between 8 and 10 a.m., we made the passage of five small branches, and of the 200-feet-wide main branch, though the water of the last was waist-high and flowing with a rapid current, besides being

ice-cold, so that the men had to wade through it in squads, holding on to one another for security. We then descended the valley again, through swamps and over boulder-strown tali, till the Shafat nala was reached after four days of extra marching.

The Shafat nala runs from the Rangdum valley, a little west of south, straight away along the eastern edge of the Nun Kun for 9 miles to the base of an impressive snow mountain marked Z 1 on the Indian Survey map, seen through the nala from Gulmatunga towering above its upper end. The nala is enclosed on both sides by precipitous mountain-walls. For some distance above its mouth its bed consists of rolling hillocks, sparsely covered with vegetation. A large colony of marmots had appropriated these as a site for a subterranean city, and their burrows pierced the ground at short intervals in all directions. These marmots were evidently social in their habits, and exchanged frequent visits, as was shown by footpaths as distinct and well trodden as those made by man, running between the different burrows and forming a network over the whole surface. Were this place of sufficient importance to have a name, it might appropriately be called Marmotville. Beyond this for 2 miles the nala ascends gently in swampy meadows covered with grass and bushes resembling dwarf-willows, interspersed with stony reaches, and intersected by numerous swiftly flowing streams.

About 3 miles above the lower end of the nala the tongue of the Shafat glacier is met with, an irregular mass of ice stretching entirely across the nala, from 80 to 100 feet high, heavily covered with red granite detritus, which gives it the appearance of a large terminal moraine. The valley-bed immediately in front of it, though somewhat strewn with small stones, has no terminal moraines to indicate that, in recent times, the glacier has extended lower down than at present, to which fact the grass-covered alluvium existing almost at the edge of the tongue also testifies. Two good-sized streams issue, one on each side of the tongue, from deep gullies extending half a mile or more up the glacier. For the next 2 miles the glacier consists of a chaotic combination of high ridges, deep ravines with perpendicular walls, hillocks, and depressions, forming a labyrinth as difficult to traverse as could well be found. This part has no well-marked moraines, either lateral or median, though it is covered with an enormous amount of detritus. Its banks on both sides consist of steep mountain slopes greatly torn and eroded by ice and water.

The upper end of this portion ceases abruptly with a sharp sweep to the south-west, below which a lower surface of smooth white ice about half a mile wide begins, occupying the eastern side of the nala, and extending to the base of Z 1, 4 miles distant. This had few crevasses, but it was covered with small pockets, filled with crystal water, from a few inches to 2 feet in diameter, and from 6 inches to 2 feet deep, at the bottom of which lay either flat stones or a thin layer of silt, which, by

absorbing and transmitting the heat of the sun, had caused the ice beneath them to melt and form the pockets. Near the junction of the white ice with the lower portion were a number of glacial tables, some of them of large size, supported on ice pedestals from 3 to 6 feet high.

Adjoining the white ice on the west, but entirely distinct from it, both in character and origin, though equally a part of the glacier, runs another section parallel with and overtopping the white one by 60 to 80 feet. This section, about a quarter of a mile wide, fills the remainder of the glacial bed. It is greatly broken and crevassed, and thickly covered with reddish granite detritus. The final destination of this



SECTION OF PERPENDICULAR ICE CLIFF, ABOUT 200 FEET HIGH, IN WHICH THE GANRI GLACIER, DESCENDING FROM THE NUN KUN, ENDS AT THE BANK OF THE SURU RIVER. PHOTO TAKEN AT 7 A.M. LOWER PART IN SHADOW.

section affords an interesting example of the application of glacial force. On its west side, about 1 mile above the lower end of the white section, a branch glacier enters. This branch is short, not over $2\frac{1}{2}$ miles in length, and perhaps half a mile wide, but, coming down from the sides of two peaks, one of them of over 23,000 feet, with a fall of 9000 feet, it presses with tremendous force upon the Shafat glacier. As a result, the red section is crowded bodily over to the east side of the glacial bed, cutting across the white section, forming a barrier to its further progress, and literally swallowing it up. The red portion then expands so as to fill the whole glacial bed, three-quarters of a mile wide, and forms the chaotic lowest 2 miles of the glacier already described.

The very abundant detritus brought down by the branch glacier is black. This crowds with the ice of the branch into the space from which the red section has been pushed, and can be traced downward for about a mile. Opposite the point of entrance, a large hillock of black material presses well into the red section rising high above the surrounding level. The eastern edge of the white section bears along a smaller black moraine, which is also swallowed up by the red portion at their point of contact.

Opposite Z 1 the Shafat glacier, which to this point ascends with a moderate gradient south 23° W., turns around the end of a spur from the Nun Kun, and pursues a course west 10° S. to a ridge 3 miles above, descending from the central one of the row of five southern Nun Kun peaks across the slope to meet an arête projecting from Z 1. This ridge rises only slightly above the glacial surface, but it forms a line of demarcation, on the north side, between the snows, which, coming from three of the Nun Kun peaks, feed the Shafat glacier, and those from the remaining two which fall to the Fariabad nala; and on the south, between those from the whole front of Z 1, and those from it west of the arête, which also fall to the Fariabad nala. The altitude of this ridge at a quarter of a mile from the wall of Z 1 is 16,911 feet. Thence it rises continuously till it ends in a peak of over 21,000 feet.

The reservoir of the Shafat glacier differs from those of the ordinary type, in that it is composed of two lateral parts or wings, over 2 miles distant from each other, the northern wing consisting of the slopes of the Nun Kun massif, and the southern of those of Z 1, the snows from both of which descend east of the boundary ridge into the intermediate depression, meeting near its middle line to form the glacier. The glacier is therefore destitute of a typical head or end basin enclosed by mountains on the west.

Its width just above the bend is about a mile, but below the ridge it widens to more than 2 miles, ascending sharply and greatly broken to the Nun Kun. The ice from the south or Z 1 wing is remarkably free from detritus, but that from the Nun Kun wing bears a considerable quantity in detached masses, which finally becomes concentrated in the red western section already described.

The glacier coming from the two remaining southern Nun Kun peaks, named by us the Fariabad glacier, descends from north to south across the upper end of and at right angles to the Shafat, contributing to the latter a small amount of ice through an opening in the dividing ridge near its centre.

We established a base camp on the spur around which the glacier turns, about 400 feet above the latter at an altitude of 15,100 feet. It commanded a view of a second tributary entering the Shafat from the east in an impressive ice-fall, and of the steep front of the splendid peak Z 1, over 22,000 feet in height, clad in a shaggy mail of ice, portions of



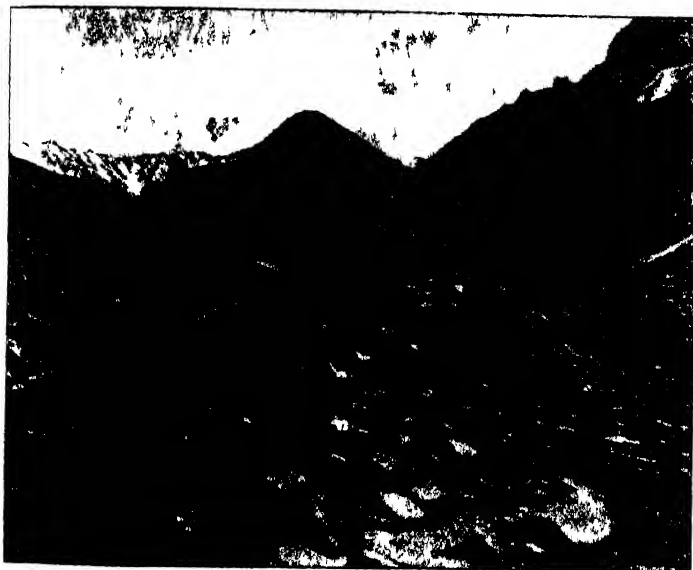
Upper three miles of Shafat glacier seen looking from N in Kur Peak. North (right) and south (left) lateral moraines on west terminating rock ridge on



● So the west half of N. 100 km basin as seen from it. Other two fold the Farabud glacier. What appears to be a small peak (left) is the peak of Gai. The peak is White Horse Peak directly

which every now and again broke away and plunged down to the glacier in resounding avalanches. After the Nun Kun massif Z 1 is the highest and most imposing mountain in the region.

While wood and supplies were being collected at this camp, we made reconnaissances of the ice-fall opposite, ascending the lower half of it, and of the higher parts of the Shafat glacier on both sides to heights of about 18,000 feet, from which an excellent idea of the glacier and its basin was obtained; but from no point could we see the conformation of the highest portion of the Nun Kun massif lying behind the five southern peaks crowning the wall above, nor could the relation of the



HILLOCK COMPOSED OF DETRITUS FORCED UP BY PRESSURE OF BRANCH GLACIER UPON SHAFAT GLACIER AT LINE OF CONTACT. BRANCH HAS A FALL OF SOME 9000 FEET. FIGURE OF SERVANT NEAR CENTRE OF HILLOCK GIVES IDEA OF SIZE OF LATTER.

highest western peak to its neighbours be determined, nor were the two northern peaks next in altitude to the highest visible, except the very apex of the north-easterly one from the ice-fall under Z 1.

Large portions of the *névé*-covered surface of the Shafat glacier, from 16,000 to 18,500 feet, were thickly strewn with *nieves penitentes*. This was the first time we had met with them in five seasons of Himalayan exploration, and I am not aware that their existence in Himalaya has been mentioned by any other observer. For a time they were regarded as peculiar to the Andes, having been observed only by explorers of that chain, until Hans Meyer, and after him C. Uhlig, discovered

them on Kilimandjaro. In the Andes they have been found from the equator to $35^{\circ} 4'$ lat. S., while those seen by us existed from $33^{\circ} 57'$ to $33^{\circ} 59'$ lat. N.

They varied in height from 8 inches to 3 feet, and had the shape of wedges or pyramids flattened at the sides with curling fluted crests, all turned in the same direction.

They were arranged in parallel lines running diagonally to the axis of the glacier, the long diameter of each *nieve* being parallel to the long diameters of others in the system and coincident with the direction of the lines. They were composed of granular snow, hard frozen in the morning, but softening more or less under the heat of the sun. No ice was found in them. The central portion of each, even when softened by the sun, was much denser than the outer surface or the surrounding *névé*, offering even in the smallest decided resistance to the thrust of an ice-axe, while the two latter could often be scraped away with the fingers. The *névé* on which they stood sloped at angles of 30° to 40° .

As this was the only one of many Himalayan glaciers we have explored presenting this phenomenon, attention was directed to the conditions obtaining on it as furnishing a clue to the mode of formation of the *nieves*. As already stated, this glacier is peculiar in that it is acephalous, being entirely open at its upper western end and fully exposed to the prevailing west winds, which sweep down its course with considerable force even in fair weather, and during storms must attain a high velocity. Another important condition not seen by us on other glaciers was the long-continued fine weather. During our Baltistan expeditions fine weather was the exception, almost daily snow-storms being the rule; but here, from early in June till our departure on August 9, the weather was continuously pleasant, only one slight squall being noted. In ascending the glacier, and on the mountains above, even to over 21,000 feet, no new snow was met with. To these two conditions the formation of the *nieves penitentes* here seen may be referred.

It is a matter of common observation that, when any object lies upon a glacier which protects the snow or ice beneath it from the sun's heat, or a condition exists that offers resistance to the same, the surrounding surface melts away, leaving an elevation of snow or ice in such place. When a rock rests on a glacier, a glacial table supported on an ice pedestal may result. Ice pyramids are sometimes seen capped with mud or fine detritus. When a portion of a glacial surface becomes more dense than that around it, the softer portions melt away, leaving the denser one standing as an upward projection.

This premised, the development of these *nieves* may be read as follows. During the winter and spring storms the wind, sweeping down the glacier, drifted the loose snow into waves and ridges. These, particularly the latter, were formed parallel to one another, with a direction more or less transverse to the axis of the glacier. The force of

the wind packed the snow composing the ridges, so that it became much denser than that in the hollows between them. Wind is the only natural force conceivable that could have caused ridges and wavy condensations of snow in the positions occupied by the nieves, upon fairly smooth slopes not exposed to avalanches and above the line of rain. This action of the wind being granted, it follows that the formation of waves and ridges of condensed snow was the first step in the process of development.

Then came the prolonged period of fine weather, when no new snow fell to cover the roughened glacial surface, when the latter was exposed



NIEVES PENITENTES ON SHAFAT GLACIER

during the long days of June and July to the full action of the sun, burning with a heat of 170° to 206° Fahr. and over. As melting proceeded, the softer snow of the hollows yielded to a greater degree than the harder snow of the ridges, thus accentuating the difference of level between the two, and the ridges themselves were sculptured out, the densest and most resistant parts remaining as apices, till, finally, the flattened pyramids known as *nieves penitentes* were fully formed.

The fact that the discrete pyramids, many of them with the ends of their elongated bases touching the similar ends of adjacent ones, stood in lines parallel to other lines, indicates (1) that they were formed out of pre-existing ridges or linear wavelets, and (2) that the condensation of snow in the ridges was not equally great at all points, but occurred in

foci, the crests of which were a little distance apart, each crest, as melting proceeded, forming the apex of a nieve.

The glacier falls from west to east, east 10° N., and the line of union of its north and south slopes corresponds with its axis. The direction of the longer diameters of the nieves and of the lines of which they formed a part, was, on the north slopes, east 20° S., whilst that of those on the south slopes was north 45° E. The former cut the glacial axis at an angle of 30° , and the latter at one of 35° . The linear rows of nieves on the two slopes were thus inclined to one another at an angle of 65° . From this it appears that the direction of the primary ridges was determined by the direction of the slopes on which they were formed, the wind remaining constant to both. The apices of the nieves on both slopes curved over more or less, giving the pyramids a convex contour on one face and a concave one on the opposite. These, as well as the overhanging hoods, with which many of them were crowned, all pointed in the same direction, i.e. towards the east, down the glacier, away from the prevailing west wind, which never varied during the three weeks we were on this glacier. Both the curving apices and the hoods were probably due to the cornices formed by the wind along the crests of the primary ridges, which being denser offered greater resistance to the sun's heat than the snow immediately under them, and persisted as overhanging parts of the nieve. It may be noted that nieves were found only above the line where freezing occurs at night, i.e. above 16,000 feet, which circumstance may be a contributory factor to their development or modelling.

From the foregoing, the conclusion may be drawn that the formation of *nieves penitentes*, certainly of such as were here seen, depends on two conditions: (1) the existence of a strong wind blowing constantly from the same direction, driving the snow into wavelets and ridges usually parallel to one another, and condensing it into compact masses at foci a little removed from one another; and (2) a prolonged period of fine weather following, during which the softer portions are melted away by the sun's heat both direct and reflected, leaving the denser parts standing in the well-known shapes. In stormy seasons the ridges, after being formed, would be protected from the sun's action by new snow under which they would be buried, and no nieves would be developed.

Six miles west of the upper end of the Shafat glacier stands a hitherto unnamed summit of 19,080 feet, called by us Mount Nieves Penitentes, and 2 miles north of it another of 20,571 feet, D 41. First ascents of both of these were made by us. The last 300 feet in altitude of the rounded top of the former as well as others of its upper surfaces were thickly covered with *nieves penitentes* of the same character as but larger than those on the Shafat glacier. Above 19,000 feet the final slants of D 41 rise at angles of 60° to 70° . These, facing south, but fully exposed to the west wind, bristled in every part quite to the summit, with

nieves rising one above another in unbroken succession. These were the largest of all, rose from an ice basis, and themselves consisted of ice. In connection with the statement of Prof. Hauthal, that *nieves penitentes* in the Andes occur exclusively in sheltered places, it is interesting to note that those observed by us at three different points in Himalaya occurred on surfaces fully exposed to wind, that the higher and more exposed the surface the larger were the *nieves*, and that the largest, most perfectly developed, and apparently the most durable of all, were found at the highest altitude, from 19,000 to 20,571 feet, where the wind would naturally be the strongest. On the Barmal glacier, springing from the



SUMMIT OF MOUNT NIEVES PENITENTES, 19,080 FEET, COVERED WITH NIEVES PENITENTES. D 41 IN BACKGROUND, 2 MILES TO NORTH.

two last-mentioned peaks and a wall connecting them and protected by precipitous mountains, and in the Nun Kun basin at an altitude of 21,000 feet, covered with snow and also much enclosed, no *nieves* were seen. Sir Martin Conway, from his observations of *nieves penitentes* on Aconcagua (see 'Aconcagua and Terra del Fuego'), concludes they are carved by solar radiation out of old avalanche beds, wind having nothing to do with their origin. *Nieves* formed in this manner would be found only on circumscribed areas in positions, which avalanche beds might occupy, and not widely distributed over glacial surfaces and on mountain-sides and tops, as in case of those seen by us, where there could be no question of avalanche beds. The conditions under which *nieves* have been observed have evidently differed somewhat in different places.

Prof. Hauthal also regards the sun as the sole agent in the formation of nieves. This hypothesis fails to explain satisfactorily the parallelism of the lines in which the nieves stand, as well as the implied selective power of the sun in melting away some portions of a glacial surface and leaving others intact, both of which can be accounted for by the known action of wind in causing parallel wavelets and ridges and condensing the snow in them.

Gussfeldt, one of the early observers of Andean nieves, is one of the few who recognize the agency of wind in the first stage of their development, but he does not mention the causation by it of foci of condensation that offer resistance to the sun's heat, which I regard as an essential factor in the process.

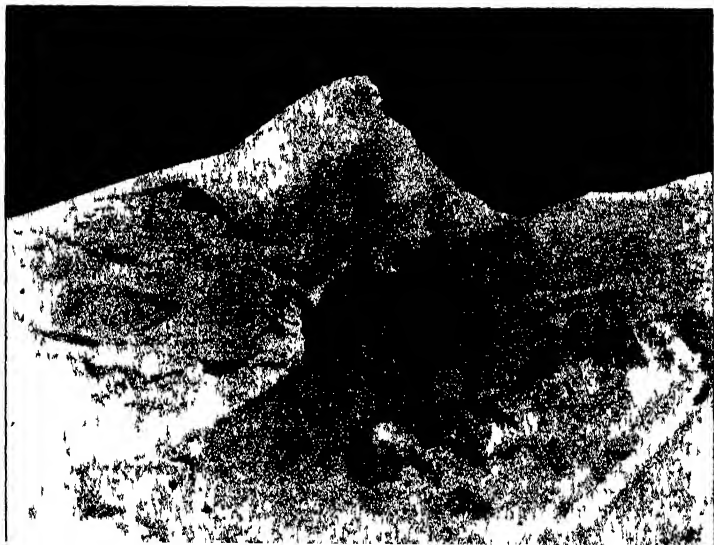
While the conclusions above stated appear to me to be the only ones consistent with existing conditions that will explain the formation of the nieves observed by me, I am quite willing to grant that condensation of snow in foci may, in certain cases, be caused by other agents than wind.*

The experience of four previous expeditions having demonstrated that coolies cannot be depended on to go much above points where rocks exist for shelter at night and water is to be had, the plan was adopted, with a view to exploring the higher parts of the Nun Kun, of taking out trained European porters to carry light camp outfit to altitudes above those which can be reached by coolies. Six porters besides the guide, who also agreed to carry a load when necessary, were judged sufficient for our purpose, and this number had accordingly been brought with us.

A reconnaissance disclosed a rock promontory projecting into the ice about 2500 feet above our base camp, with screes beneath it, where coolies could pass the night; and about 2200 feet above that, among the icefalls at the base of a snow-needle, a small sloping snow-plateau, which the coolies, by starting early from their night bivouac, could reach in time to return to the latter the same day. This was the highest point at which they would be available. Basing our plan of attack on the upper portion of the massif on the existence of these two *pieds à terre*, a good supply of wood and food was forwarded to the promontory, and two days later four porters with coolies were sent ahead with their own and our extra outfit, with orders to remain over night at the promontory, move up next morning with the coolies to the plateau, and make a second camp there, sending the coolies back to us. From here they were to push on and establish a third camp with extra Mummery tents at the highest available point, and then return to and await us at the second camp.

* For some further details, see *Zeitschrift für Gletscherkunde*, Band ii. Heft i., July, 1907, p. 22.

On July 25, Mrs. Bullock Workman, myself, Savoye, and two porters, with fifteen coolies, followed, climbing at first over great moraine masses, and later over tumbled and crevassed slopes of ice and snow lying between the giant rock-ribs descending from the peaks above. We saw many *nieves penitentes*, some of them of large size. We camped on snow just above the base of the promontory at an elevation of 17,657 feet. The minimum night temperature was 17° Fahr. The next morning we continued on up still wilder ice-slopes, steep and fatiguing, greatly broken, and seamed with wide blue chasms lined with icicles, to the second camp, where the four porters were waiting. This camp stood at



WHITE NEEDLE PEAK, ONE OF THE ENCLOSING BARRIERS OF THE NUN KUN BASIN; ALTITUDE ABOUT 21,800 FEET NOTE PROFILE ON RIGHT OF APEX. THREE BLACK DOTS IN CENTRE ARE PORTERS DESCENDING SLOPE.

19,900 feet on a small sloping surface at the base of a ragged wall, from which at intervals great icicles were broken away by the wind and hurled down in dangerous proximity to the tents. Two hundred feet distant below the camp a wide bergschrund yawned. The coolies marched well to this point, though some of them were sick at the last, and nearly all complained of headache. They were allowed to return to the lower camp on arrival. The minimum temperature here was also 17° Fahr. On our return it was 10° Fahr. The wind blew down upon us in strong gusts the whole night, shaking the tents so that we feared we should be carried down into the bergschrund. This, with the altitude, the effect of which all felt decidedly, effectually prevented sleep.

From here the whole party of nine started upward together. The only possible route led up the steep face of the ice-wall, and above it involved the traverse of a long, sharply inclined, curving ice-slope covered with snow. Had the passage of our caravan started an avalanche, as we feared might occur, we should have been carried down over the wall into an abyss of unknown depth running along its whole base. Two weeks later, when the snow had melted or become converted into ice, this slope would have been too dangerous to attempt. Its top lies at an altitude of about 21,000 feet, at the base of a beautiful snow-needle some 800 feet higher, which crowns the extremity of a short arête projecting from the highest Nun Kun peak. Up to this point we had seen nothing of the massif except the slopes facing the Shafat glacier. On reaching the crest we found we were standing, not on a col between the first and second of a line of peaks, as the Survey map and previous statements had led us to expect, but just above the brow of a glacier emerging from a great oblong snow-plateau or basin, about 3 by $1\frac{1}{2}$ miles, enclosed by six great and one smaller peak, the highest of which, 23,447 feet, rises up by itself steeply from the plateau unconnected by cols with any of the others. Descending into this basin, we reached the third snow camp, which had been established at an altitude of 20,632 feet. The minimum temperature here was 4° Fahr.

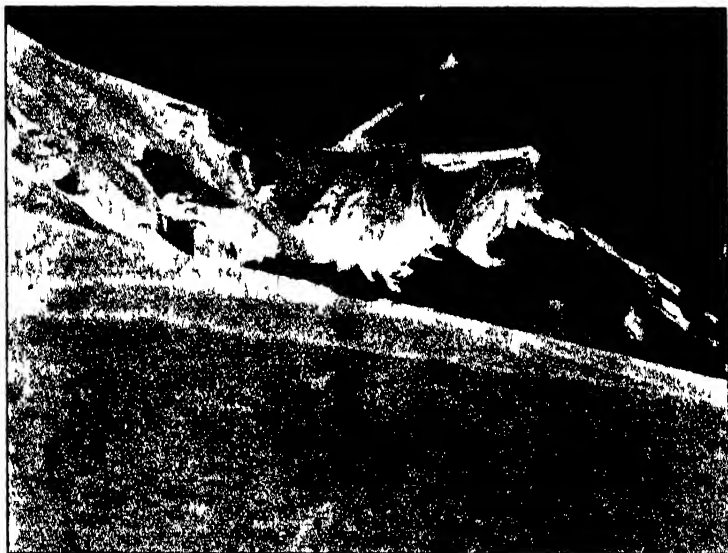
Reconnaissance from this and the preceding camp showed the ascent of the highest peak to be impracticable from this plateau, certainly for our party, as it could be assailed only at one point, above which it would be necessary to camp, the arêtes leading to which are so steep that no loaded porter could probably surmount them, and, if passable at all, would tax the powers of an unloaded expert to the utmost. We therefore moved the camp the next morning 3 miles farther to the upper end of the plateau, at the base of the peak next in height, which promised better conditions. Here our fourth snow camp was pitched at an altitude of 21,300 feet. The porters could only bring half the necessary kit at one time, so they and the guide descended to the third camp for the rest, intending to return that afternoon. But a dense mist after midday and the softening of the snow by the great heat prevented their return, so that Mrs. Bullock Workman and myself were left to pass the night alone in the almost terrifying silence and loneliness of this untrodden solitude of snow.

We did not sleep. As I have found before under similar circumstances, the absolute silence that reigned during the watches of the night, in the absence of sleep, proved almost as nerve-wearing as an excess of noise. In such a situation one has the feeling of having completely lost touch with the material world, and the imagination, uncontrolled by the suggestions of ordinary sounds, runs riot among fancies and possibilities neither wholly pleasing nor reassuring.

The afternoon was windless and oppressively hot. The sun shone

through the drifting mist with a sickly light, but with a heat that sent the mercury in the solar thermometer up to 193° Fahr. at 2 o'clock, and to 142° Fahr. at 3.30 o'clock. The heat was equally unbearable within and without the tents, and all the harder to endure because of the mist, which, while shutting out all view of the world around, shut in the heat, so that it became a palpable entity penetrating to every part of the system with depressing effect. At sunset the temperature fell to freezing, and an hour later to 10° Fahr., reaching a minimum of -4° before morning, a difference of 197.

At daylight, Savoye and two porters arrived, their faces blue with



SECOND SNOW-CAMP (WHITE NEEDLE CAMP) AT 19,900 FEET (AIRY, 20,251 FEET), AT BASE OF ICE-WALL BENEATH WHITE NEEDLE PEAK. ROCK PEAK, ONE OF SOUTHERN ENCLOSING PEAKS OF NUN KUN BASIN, IS $1\frac{1}{2}$ MILE EAST OF THE CAMP.

cold and their moustaches covered with ice. Having drawn on our frozen boots, we set out with them to ascend the steep ice-covered flank of the mountain above, its lower half broken into ice-falls, where almost every step had to be cut. At an altitude of 22,720 feet, as the mists which almost daily obscured the mountain-tops towards noon were gathering, I stopped with one porter to photograph, while the latter were yet visible, and Mrs. Bullock Workman went on with the other two to complete the ascent, attaining an altitude of 23,300 feet. Camp was reached at 7 p.m. The temperature fell that night to -6° Fahr.

I have stated the altitude of our highest camp as 21,300 feet. This

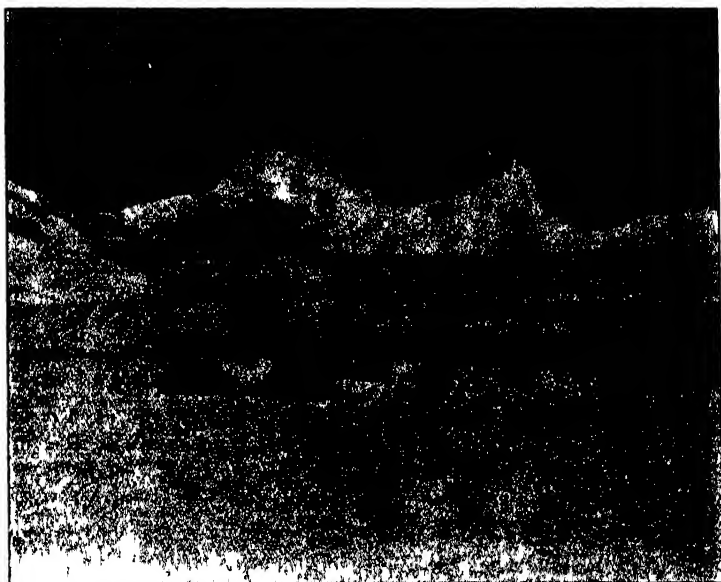
was measured by hypsometric readings compared with simultaneous ones at the lower Government station of Dras, 34 miles distant, where readings were taken for us three times daily during our absence. The same readings, calculated by Airy's table, make its altitude 21,600 feet. The variation being so great, and Airy's table differing from others in placing sea-level at 31 inches and giving relatively higher altitudes for very low pressures, the results of calculations by it have not been used. If Airy's table can claim greater accuracy than the older tables, then the altitude in question must be regarded as 21,600 feet. In either case this camp is of importance practically, as I hope presently to show, as representing, I believe, the highest point to which, up to date, November, 1907, tents have been taken and occupied, and the highest measured point at which mountaineers have passed the night. Two parties have recently claimed to have bivouacked in the open without tents at greater altitudes, Mr. Reginald Rankin on his descent from Aconcagua being overtaken by darkness at an elevation he states as 22,000 feet, and Dr. Longstaff, with guide and porter, under similar circumstances, having spent a night in the snow at what he "thinks" was 23,000 feet. From their published accounts it appears that in neither case was the altitude mentioned determined by any kind of measurement.

It has been asserted several times within the past year that Mr. W. H. Johnson, in the employ of the Indian Survey, camped in 1865 in the Kiún Lún at an altitude of 22,000 feet. I have been unable to find, in Mr. Johnson's account of his work in the 'Synoptical,' Vol. 7, of the Indian Survey, and in the *Journal* of the Royal Geographical Society, any mention of such a camp. If any camp, which Mr. Johnson thought approached this altitude, was made, it must have been on the peak E 61, the only peak in the region exceeding 22,000 feet, which was measured in 1862 by a Survey employé and its height given as 23,890 feet. This measurement was unchecked, and the details of it were so meagre that the Survey did not endorse it, expressly stating that, for reasons given, they considered it too high—as I have been credibly informed, probably 1000 feet or more too high. Any camp, therefore, that Mr. Johnson may have made on this mountain, the altitude of which he would naturally estimate with reference to the assigned height of the mountain itself, would have to be lowered by the same amount, which would bring it in any case below the altitude of our recent highest camps.

In order to place mountaineering on a scientific basis, among other things, the necessity of the measurement of altitudes reached, by one of the methods recognized as fairly reliable, is obvious, since such measurement alone defines with approximate exactness the height at which observed altitude phenomena may occur, and without it observations lose an important part of their value. In this connection I would call your attention to some of the subjective experiences, particularly at

night, of the nine Europeans engaged on this occasion, not merely in high climbing, but in carrying loads, making and occupying camps measured at 19,900, 20,632, and 21,300 feet (by Airy's table 20,251, 21,093, and 21,600 feet).

Only one of the party—a porter—suffered from mountain sickness. Although complaining of headache and weakness at the third camp (20,632 feet), he started to go to the fourth with a light load of instruments, but was unable to keep up with the rest of us and soon fell behind, showing unmistakable signs of mountain sickness. Before



THIRD SNOW-CAMP (CAMP IIALIA) AT 20,632 FEET (AIRY, 21,093 FEET) NEAR SOUTH-WEST END OF NUN KUN BASIN, EXTENDING NORTH-EAST OF CAMP TO TWO OTHER ENCIROLING PEAKS 3 MILES DISTANT ONE AT LEFT IS PINNACLE PEAK, 23,800 FEET, ASCENDED JULY 29, 1907.

reaching an altitude of 21,000 feet, though naturally a strong and healthy man, he collapsed entirely and became helpless. He complained of loss of sensation in his hands. His woollen mittens being drawn off, his fingers were found white and stiff, and, if not already frostbitten, on the point of becoming so. Vigorous rubbing and pounding of his hands finally restored circulation, when he was sent down to the third camp. The fact that his hands, even when protected by thick woollen mittens, were brought by the cold to the verge of frostbite, while my own, without any covering, were comfortably warm, shows how profoundly the circulation and vitality are prostrated by mountain sickness, and how

dangerous it is for one suffering from this malady to be exposed to the cold of high altitudes.

At the second camp, 19,900 feet, and above, three suffered with severe headache, pain in back and lower limbs, especially at night, and a fourth with headache at night; while three were troubled with cough without discoverable pharyngitis or bronchitis, which promptly disappeared in two cases on descending to the base camp, but persisted for a week in the third. These symptoms did not incapacitate any one, except the porter who was ill, from accomplishing the daily work.

Every one, as was to be expected, felt the effect of altitude on the respiration, though some to a greater extent than others. This, as usual, manifested itself by shortness of breath and panting on slight exertion. In the erect position, when resting, the respiratory disturbance was not so noticeable, being marked only on movement, but at night on lying down it became more urgent, being accompanied by a feeling of oppression, for the relief of which a number of deep inspirations were necessary. The frequent repetition of these wearied the respiratory muscles and even became painful. This constant gasping for breath interfered with sleep, no matter how tired one might be, and if, at last, after a long period of prostrating wakefulness, one did doze for a moment, one would immediately start up with frantic efforts to obtain sufficient oxygen to relieve the stifling sensation which threatened to terminate one's existence. During the five nights at our three highest camps no one obtained more than a few snatches of sleep, and four, of whom I was one, practically none at all. Those nights are not easily forgotten, when one lay sleepless on the snow, in the cold, and silence, and darkness, struggling for breath, and counting the slowly dragging hours with a feeling that the strain could not be endured till daylight. It is scarcely necessary to say that even the strongest could not hold out for long against the depressing influence of loss of sleep, combined with the lowering of vital energy due to the scarcity of oxygen at these high altitudes. We were conscious of a distinct decline in strength on the last two days, and after six consecutive days of hard work and five sleepless nights every one felt an irresistible desire to relieve the tension by a descent to a lower level.

I have elsewhere, in connection with our highest camp in the Chogo Lungma region, at 19,358 feet, where five Europeans were affected in a similar manner during two nights, suggested the possibility that, in attempts on the highest Himalayan summits, where camps would have to be made at from 23,000 to over 27,000 feet, insomnia alone might prevent success.* This corroborative experience of nine active mountaineers at camps approximately 550, 1300, and 2000 feet higher than that above mentioned, at all of which respiratory disturbance and

* See *The Alpine Journal*, August, 1905, p. 14.

insomnia were distinctly more pronounced, being most marked at the highest, appears to me now to justify the opinion that insomnia will be found to be an adverse factor in high mountain work no less formidable than cold, deficiency of oxygen, and weather, and much more so than mountain sickness, inasmuch as it appears likely to affect a larger number of climbers.

Our primus stoves and hypsometer lamps felt the altitude quite as much as we. The alcohol in the lighting cups of the former would not burn until the cups had been heated by the application of half a dozen burning matches, and the petroleum gas issuing from the burners was



FOURTH SNOW-CAMP (CAMP AMERICA) AT 21,800 FEET (AIRY, 21,600 FEET)
AT BASE OF PINNACLE PEAK. ITS DESOLATE SITUATION IS APPARENT.

only partially consumed when saucepans were placed at the ordinary distance above the latter, the rest escaping in smoky ill-smelling fumes. To insure complete combustion it was necessary to give the flame its full height, so that the air could have access to it from every point. With this precaution petroleum in a primus stove makes a more efficient fuel and generates a much greater heat at high altitudes than alcohol used in any apparatus I have seen. The wicks of the hypsometer lamps were also lighted with difficulty, two or three matches in succession being required, and when they were lighted, placing the lamps in the metal jackets promptly extinguished the flame. Having had the same experience previously, we had had the burning-tubes replaced by new ones of double the diameter, but this did not help the matter. The ordinary

jacket does not admit sufficient oxygen to insure combustion at high altitudes. The lower half of the jacket, at least, should be made of wire-gauze so as to admit all the air possible.

We found the low temperature, -4° and -6° Fahr., and even that of 17° and 10° Fahr. with strong wind, trying, at night. Arctic explorers endure temperatures much lower than these without difficulty, but their work lies near sea-level, where the atmospheric pressure is more than double that at 21,000 feet, and they can encase themselves in furs without suffering from the weight. There the air also contains sufficient oxygen to enable them to breathe freely under any degree of exertion, and to sleep soundly, thus sustaining the bodily heat and vital forces at a normal limit, so that they can offer a maximum power of resistance to cold. But at high altitudes, where vitality has been lowered by hard work, loss of sleep, and deficient oxygenation, where only a closely calculated minimum of clothing and bedding can be carried, an amount really insufficient to protect one against cold, a temperature of zero means a good deal more than it does to the Arctic explorer. The mountaineer at high altitudes is called upon to endure Arctic conditions without the means of protection available to the Arctic explorer. All our party, in addition to flannel-lined Mummy tents, with ground-sheets sewn in, were provided with rubber ground-sheets and well-padded eider sleeping-sacks, enclosed in outer ones of camel-hair or army blankets; but these were inadequate to prevent us, even when wearing our thickest clothing besides, from feeling the cold sensibly at night at the second camp, and to a much greater degree at the two highest camps. Two thousand feet higher, where the cold would be considerably greater, we should probably have suffered more severely.

An effect of altitude upon the mind, which was noticeable here, as it has been elsewhere above 18,000 or 19,000 feet, deserves mention. Owing, perhaps, to a general loss of energy and to the disturbance of respiration and circulation incident to even moderate exertion, a mental condition of irresolution and disinclination to effort supervenes. The simplest actions assume formidable proportions, and even photography, which one recognizes as of the highest importance and which at ordinary altitudes is not a difficult process, becomes a bugbear; while the ascent of a peak, a really arduous undertaking at high altitudes, looms up as an almost impossible proposition. One has, therefore, often to call the will into play to its utmost power to force one's self to carry out what has been proposed. Those who are destined to raise the mountaineering altitude record much higher than it now stands will undoubtedly be persons of strong will and self-control.

Another point of interest is, that the guide and porters were able to carry loads of 40 lbs. to an altitude of 21,300 feet. The gradients, except that of the ice-wall above the second camp, were not steep, and the last

two marches upward were only about three hours; but to carry loads of 40 lbs. up inclines of 25° to 35° in snow ankle-deep, at that altitude, requires strength and endurance. How much higher they could have gone, or up how much sharper slopes, I will not venture an opinion. Savoye expressed grave doubts whether they could carry the same loads up much steeper gradients than were encountered, for at altitudes like these the difficulty of carrying a given load increases enormously with a comparatively slight increase in gradient. These men were certainly more efficient than coolies, and with their aid we were able to make two camps at altitudes which could not have been reached with coolies.

Peak D 42.



VIEW DOWN BARMAL GLACIER FROM POINT ABOUT 20,000 FEET HIGH ON D 41
SLOPE IN FOREGROUND COVERED WITH NIEVES PENITENTES.

The question to what height trained mountaineers will be able to carry outfit requisite to camping must be left to the future to decide. With the various obstacles to high climbing more accentuated in proportion to altitude, it seems certain that loads will have to be reduced as altitude increases, until a limit will at last be reached where not enough can be carried to support life and protect the mountaineer against cold and weather. That limit is likely, I fancy, to be found considerably below heights at which camps will have to be made to render the highest summits accessible.

One of the most interesting features of the Nun Kun is the plateau, or snow-basin, where we camped, which, enclosed by its circle of seven

glittering peaks, sits like a diadem on the brow of the lofty massif which it crowns. Its surface is undulating, being depressed in the centre, but rising towards the bases of the peaks, where it shades off into the mountain slopes. The altitude of its highest part, which is at the north-east end beneath the second highest peak, is 21,600 feet. Thence it slopes away to the south-west to about 20,300 feet at the Ganri outlet under the highest peak. Its shape is oblong, its long diameter running north-east and south-west being 3 to $3\frac{1}{4}$ miles, and its conjugate diameter about $1\frac{1}{2}$ mile. The peaks rise sharply from it, and descend more sharply, largely in perpendicular precipices, on the outer side. The four north-east peaks are connected by rock and snow saddles. The other three, including the highest at the south-west end, stand alone, rising directly from level ice. Around the bases of these three the basin has four outlets, by which its snows escape to form the ultimate source of the three principal glaciers of the massif, one stream descending north-west between the highest peak and the one next north-east to make one head of the Ganri glacier, two others to the south to feed the short but broad Fariabad glacier, and the fourth also to the south, to contribute to the north reservoir of the Shafat glacier. It is very unusual for three glaciers to originate in a single basin.

The Ganri glacier has two reservoirs, or heads, the larger one drawing its snows from the whole north-west side of the highest Nun Kun peak, from the north slope of an arête running from the latter to the Barmal ridge (an arête of D 41), and from the north-east face of D 41, which unite in a converging snow-field 3 miles wide at its upper part, with a fall from about 19,000 to 17,000 feet. The second head descends from the Nun Kun basin, leaving the latter at an altitude of about 20,300 feet. The two come together at the end of a rock arête of the highest Nun Kun, just above the entrance to a gorge enclosed on both sides by ragged mountains descending steeply to the Rangdum valley. The upper end of the gorge appears to be at an altitude of about 17,000 feet. From this point the glacier, crowding into the gorge in a greatly narrowed stream, tumbles more than 5000 feet in a continuous line of seracs to near its termination 8 miles below its sources.

The most remarkable feature of this glacier, and one seldom seen in purely mountain glaciers, is its tongue, which ends abruptly at the river-bank, like that of a polar glacier extending to tide-water, in a perpendicular ice-precipice about 600 feet long and 200 high. Its successive layers, as they separate themselves, fall in miniature icebergs into the current, by which they are carried away and strewn along the river-banks below. The river washes the base of the whole front of the tongue, apparently cutting under its lower edge somewhat; but the depth to which it can undermine the ice must be slight, as the latter does not project appreciably into the river, but breaks off at the edge of the bank. Here a river not many feet in depth is seen to produce

the same effect upon a massive glacial tongue as is produced by the deeper waters of the polar oceans upon glacial tongues that push into them.

West of the tongue, and separated from it by a considerable interval, a giant lateral moraine, over 200 feet high, and towering above it by more than 100 feet, extends entirely across the valley, and similarly a shorter lateral moraine projects on its east side. These moraines, together with the boulder-masses piled up in the space between them, show that the glacier was formerly much longer, wider, and thicker than at present, covering the whole width of the valley and impinging against the opposite mountain walls. The amount of detritus brought down to build these moraines and boulder-masses was enormous. At present the glacier, as seen both from above and below, appears remarkably clean and free from detritus.

The third or Fariabad glacier, beginning in the two southern outlets above mentioned of the basin, and reinforced by snows from the external slopes of the two western peaks, descends rapidly in a confused mass of ice-falls, caverns, crevasses, and seracs, directly south to the side of the Z 1 glacier above the opening of the Fariabad nala. It is separated from the Shafat glacier on the east by the ridge before mentioned, and is bounded on the west by a large spur from the highest Nun Kun, descending to the Fariabad opening. Its length is 4 and its width 2 miles. It is a most dangerous glacier to venture on.

The three principal Nun Kun glaciers are not very long, being respectively only 9, 8, and 4 miles in length, but, springing from heights of from 22,000 to over 23,000 feet, and falling 10,000 to 11,000 feet in these short distances, they possess great potential energy, developing ice-falls, ice-precipices, and seracs as large and high, crevasses and abysses as wide and profound, ridges and ravines as pronounced, and moraines as gigantic, as those found on glaciers of far greater size and length.

We decided next to try to complete the circuit of the Nun Kun. Reconnaissance showed that no passage to the west from the top of the Shafat glacier at a high level existed, the way being barred by the spur descending from the highest Nun Kun to the Fariabad opening, followed by a succession of arêtes, snow-basins, and precipices; but if we could get down over the Fariabad glacier, or over a sharp rock-spur of Z 1, to the Fariabad opening lying 4000 feet directly below, we might find a way by a nala that was seen to ascend north-west from the last, and to end in a great amphitheatre of ice and snow, at the top of which a saddle might be found. This would be a matter of pure pioneering, as the survey map was of no assistance,* and none of our coolies knew

* Those who are at all acquainted with the history of the Indian Survey know that its work in the northern part of Kashmir territory was, and under the circumstances had to be, more in the nature of a reconnaissance than of a finished survey, salient points being fixed and intermediate details, which could not be seen, being

anything of the proposed route. Success was by no means certain, but we determined to try it.

We accordingly cut loose from our base camp on August 9, with fifty coolies carrying a minimum of lightest outfit and nine days' supplies, sending all other luggage back to Suru in charge of a Gurkha and shikari by way of the Rangdum valley. We ascended the Shafat glacier, crossed the ridge above it, and descended the east edge of the Fariabad glacier till it plunged down so steeply and became so broken that it was no longer available. We then crossed to the rock-spur of Z 1 at an altitude of about 16,000 feet, and descended with considerable difficulty its precipitous greatly broken face, covered with loose rocks and *débris* for some 2000 feet to the Z 1 glacier, which, falling from the top of the mountain in a very steep ice-fall, fills the Z 1 nala almost to its junction with the Fariabad nala. A short distance above the tongue of this glacier the tongue of the Fariabad glacier, coming down from the Nun Kun in a great broken ice-wall, ends abruptly at its edge without any terminal moraine. The tongue of the Z 1 glacier ends in a steeply falling front of discoloured ice, 300 feet or more in height, with a sharply defined curving contour thickly seamed with longitudinal crevasses. Here, also, there is no terminal moraine, though the nala-bed below is sprinkled quite thickly with *débris*.

Glaciers do not by any means always form terminal moraines. As to this fact, there is no difference of opinion among glaciologists, in whatever manner they may account for the formation of such moraines. The one hypothesis, that terminal moraines result from the gathering up and pushing along of the subglacial ground-moraine material, and even, as some hold, of the ploughing up of the terrain beneath the ground-moraine by an advancing tongue, and to a less extent by a stationary one so as to form a wall at its end, fails to account for the cases where no terminal moraine results, even under the most favourable conditions of active advance. It also ignores or minimizes the part which moraine material carried by the tongue must play in the process of moraine building. It is evident that no moraine would be formed by a tongue in retreat.

The other hypothesis, that such moraines are wholly due to the deposition and excretion of the material lying in and upon the tongue, presupposes the co-operation of two factors: (1) that a glacial tongue should carry a considerable quantity of detritus, and (2) that its front should remain stationary long enough for the detritus to be deposited in sufficient quantity to form a moraine, i.e. the ice from above must advance to the terminal line as fast as the ice there melts and discharges its detritus upon that already deposited, till the process is completed. By this

filled in on the resulting map by inference. It is, therefore, no discourtesy towards the Survey for those exploring the hitherto unvisited intermediate parts to mention the absence or inaccuracy of topographical details on the map.

hypothesis, if a tongue carries no moraine material, no moraine should be formed under any conditions of advance or retreat. This fails, in its turn, to account for those cases where glacial tongues bearing no observable moraine-material have been found to be bounded by high and large terminal moraines. If the end of a tongue recedes faster than the ice above it advances, no moraine results, its detritus being spread more or less evenly over the denuded surface without accumulating at any one point.

The tongues of the two glaciers above mentioned, at present, furnish examples of the absence of one of these factors in each case. The Fariabad tongue bears no detritus to speak of, and has no deposit at its end. That of Z 1 has been receding constantly and rather rapidly for some time, and, though carrying considerable *débris*, has left it evenly distributed over the nala-bed in front of it, not having paused long enough at any one point to build an elevation that might be called a moraine. Half a mile farther down the nala are some larger *débris*-deposits overgrown with vegetation, which might be regarded as terminal moraines.

The successive terminal moraines often found in front of glaciers, with intervals between them little or not all strewn with detritus, show that the same glacier, according to the presence of both these factors or to the absence of one or both, may build terminal moraines at one time and fail to do so at another. The smoothness of many such intervals would indicate that, during a period of recession, the respective tongue carried but little detritus. In Himalaya, glaciers may recede for considerable distances without leaving behind *débris* of any size, as in case of the Chogo Lungma tongue, cited in a paper read by myself before this Society (see *Geog. Journal*, March, 1905, p. 251), which has retreated 1184 feet in forty-two years, leaving a smooth river-bed below it. Observed facts appear to show that there is truth in both the above hypotheses, and it is not improbable that many moraines are formed by the combined action of both the methods they suggest. In 1902 and 1903, when I saw the tongue of the Tippur glacier, near that of the Chogo Lungma, it was adding to its large terminal moraine at a rapid rate by the deposit upon the latter of detritus from its upper surface.

From the Fariabad opening we followed up the nala leading north-west (North-West Nala). About a mile above the former, west of the rock-spur from the highest Nun Kun, a glacier from the base of that peak reaches the north side of the nala in an ice-fall, but does not penetrate it. Two miles above this, a glacier, descending from the mountains on the south, fills the nala for another mile. Two hundred feet in front of its tongue is a high terminal moraine composed entirely of fine brown sand with ice still beneath it. This appears as if it might have been formed by the ploughing up of the nala-bed by the glacial tongue during an advance. The sand has protected the ice on which

it rests from the sun's heat, while the uncovered ice behind it has melted entirely away. Higher up another glacial tongue enters the nala from the south, on which are two picturesque lakes. After ascending the steep glacial amphitheatre in which the nala ends, we came to a snow col at 17,347 feet, south of Nieves Penitentes peak, and east of the head of the Bara Zaj Nai nala, to which most dangerous-looking ice-slopes descend. We named this North-West col.

The only practicable passage from here appeared to be towards Mount Nieves Penitentes. A gentle descent of half an hour brought us to its base. Here we were overtaken by a dense mist. Having fortunately taken bearings before it set in, we pushed up an ascending snow-slope in the mist between an ice-fall and a bergschrund, and finally reached a rock-arête rising above the snow close under the western angle of Mount Nieves Penitentes at an altitude of 17,260 feet. This our coolies, who arrived two hours later, and who up to this point could give us no information, recognized and called the Barmal la. Here we camped four nights. The Barmal la commands a view of the head and of much of the course of the Barmal glacier, a large and handsome sheet of ice springing from the slopes of Nieves Penitentes peak and of D 41, 2 miles north, and from a high rock-wall connecting them, which we named the Barmal ridge. It runs westward for 8 miles, walled in on each side by a line of jagged peaks, and ends among green slopes south-east of a mountain-cirque enclosing the reservoir of a branch of the Bhot Kol glacier. The width of the Barmal glacier near its origin is about 2 miles, but it soon narrows to 1 mile, maintaining this width for over 5 miles. This glacier is not on the Survey map. It has, however, evidently been long known to the natives, who often cross it with yaks in going between Tongul and the Bara Zaj Nai, and also the Fariabad nala. Local tradition credits one European with having visited it many years ago. In 1902, Rev. C. E. Barton and Dr. A. Neve, ascending from Tongul, crossed it to the Bara Zaj Nai nala at a point about 5 miles west of the highest Nun Kun. In 1904, Dr. Neve reports having crossed it again at the same point, and having climbed on the side of D 41 to a height stated as 19,200 feet.

On two successive days we made first ascents of Mount Nieves Penitentes, 19,080 feet, and D 41, 20,571 feet, from the summits of which we obtained not only comprehensive views of the surrounding region, but unobstructed views of the western end of the Nun Kun massif, of the two reservoirs of the Ganri glacier, and to the west the full sweep of the Barmal glacier to its end 8 miles beyond.

In the February 1903 *Alpine Journal*, Dr. Neve shows a photograph of a section of the Barmal glacier taken from the pass to the Bara Zaj Nai, which he designates as "the Great Western Glacier of Nun Kun." He further states in his 'Tourist's Guide to Kashmir,' 6th edit., 1905, p. 122, that Mr. Barton and he, in 1902, "discovered that the Bhot Kol



Pan rai a fro n i t m i t f o r t e P a k l e f t l e f t B a q R d a r u n f i t t l o w e r l i g
 (two e p i c o n e n t m a i f i e a l o f m a l m a l a c i e s) P a k o n r i b e t l e t N i k u t i w a r e i w h i c h a t u r n e d t o (c r i s t a l l i n e c o n t r o l t h e
 R i c k e a n d l y t l a t t e r i n t h e G a n n i l a m a l a c i e s) o r t h a l a s e e n i t l e t h e n r t h w a t a i t h l o o k a t e x t i t h i s b e e n r e f B a r r i a l



Parwana from summit of D-41 2051 feet shown, two heads of Ganri glacier the latter in foreground coming from the host Nun Kun (the Barnal Ridge and D-41)

glacier comes all the way from the Nun Kun peak." Also in the February 1905 *Alpine Journal*, p. 350, he speaks of the Barmal glacier as "the upper Bhot Kol glacier." From these quotations it is evident that he supposes the Barmal to be identical with the Bhot Kol glacier, and that its ultimate source is the highest Nun Kun peak.

I cannot agree with him in either of these suppositions. As regards the first, it may be said, having been over the same ground, and having also traversed the Bhot Kol glacier from end to end, I found no evidence that the two glaciers are identical. The lower end of the Barmal glacier, where Dr. Neve supposes the connection to be, is separated from the Bhot Kol by mountains and ridges from 17,000 to 19,000 feet in height. As regards the second supposition, from the summits of Mount Nieves Penitentes and D 41, the south-west and north-west faces of the great pyramid of the highest Nun Kun are seen to be separated by a sharp rock-arête, broken at one place, running down the pyramid from its apex to its base on the high plateau, where the arête is lowest. Thence it passes directly west, rising as it goes, and joins the Barmal ridge at its highest central point, about 19,000 feet.

This arête and the Barmal ridge turn all the snows coming from the Nun Kun peak, and those of the plateau between this and the Barmal ridge, into the west reservoir of the Ganri glacier on the north, and towards the North-West nala on the south side, and, as can be seen from these photographs, not a particle of snow from the Nun Kun can enter the Barmal glacier. Had Dr. Neve climbed sufficiently high on D 41 to fully overlook the Barmal ridge, he would have seen the impossibility of this supposition.

The ascent of Mount Nieves Penitentes and of D 41 was by no means easy. Both are peaks of the very first order. One slope of the former, requiring three-quarters of an hour to climb, was steeper than could be measured by the scale of Abney's level, being apparently 70° or 72° . The last 1500 feet of D 41 was also difficult, consisting of ice-slants varying from 60° to 70° . Fortunately these were wholly covered, as stated, with *nives penitentes*, forming a precipitous giant stairway of ice, by which we were able to scale it in safety. Had its surface been smooth, the undertaking would have been much more difficult, more fatiguing, and highly dangerous. Half an hour after the top was reached a thick mist swept up from the Barmal glacier and enveloped us, shutting out all landmarks. This was accompanied by an icy wind, which congealed the breath into icicles on our moustaches and covered our clothing with feathery fringes. Recognizing the danger both of remaining and of descending, we preferred to attempt the latter, and succeeded in getting down in two parties invisible to each other, by following the slight spoor made in ascending. Previous to departure a stone cairn was built on the summit and notes of the ascent placed in it.

The Barmal la stands perhaps 600 feet above the Barmal glacier, at the top of a very steep ice-wall cleft by two bergschrunds, to ascend or descend which requires a good knowledge of ice-craft. Our coolies were powerless to negotiate it alone, which fact prevented many of them from deserting during the four days we camped there, and even the guide and porters would not venture on it unroped. Two rock-cairns stand on the summit of the la. By whom they were made we could not learn. No records were found in them, and I know of no account of any European having visited this place. As it is practically certain that natives could not reach it from the Barmal glacier unless the ice-wall were greatly changed, it may be surmised that some party, having come up to it from the south side, mistaking it for a snow-pass somewhat farther west, and having found the descent to the Barmal glacier barred by the ice-wall, built these cairns as a beacon by which the place might in future be avoided. The existence of other cairns on ledges to the south, indicating the way to the other pass, supports this view. Half or three-quarters of a mile west lies the snow-pass referred to, accessible by easy snow-slopes, leading from the Barmal glacier to the Bara Zaj Nai. It is over this pass that the natives take their yak-caravans from Tongul, and this was the pass used by Dr. Neve, also under the name of the Barmal la.

The Sentik la is a depression about a mile distant from D 41, in the ridge leading west from it. Over this pass lies the way from the Barmal glacier to Tongul, the nearest village in the Suru valley. Below the pass the Sentik glacier, about 3 miles long, coming from the north side of D 41 and neighbouring mountains, and receiving two ice-falls from the west reservoir of the Ganri glacier, descends north to the head of a very steep nala, enclosed on both sides by jagged rock-peaks, below which slopes and ridges fall away to Tongul, a short march from Suru. By this route we returned to the latter village, having covered over 90 miles of rough country in completing the first circuit of the Nun Kun, besides many more in exploration and ascents.

August 18 and 19 were very warm days at Suru, the sun burning with unusual fervour. We had found during the summer, as during those of 1902 and 1903, sun maxima of 200° to 206° Fahr. at high altitudes to be not at all uncommon, but had never known them to attain the figures reached on these days. On the 18th, at 1 p.m., the sun thermometer registered 206° , and, at 1.15, 212° Fahr. As this last figure seemed incredible, the instrument, which was so hot that it could scarcely be touched by the hand, was raised to the vertical position and shaken, but the mercury did not fall. At 1.25 it reached 216° . This was not only an unusually high maximum, but it occurred at an unusually late hour, most maxima I have observed occurring at or before 1 o'clock.

On the 19th, at 12.30 p.m., the thermometer registered 196° . At

12.45, 218°. At 1, through a thin film of cloud, 217°, not falling when placed vertical, and at 1.5, 219° Fahr. The altitude of Suru is 10,850 feet. As sun-temperatures increase in proportion to altitude, what must the temperatures on these days have been at over 20,000 feet?"* On these, as on other occasions when I have noted high temperatures, the maxima showed themselves in sudden waves or flashes of heat lasting a few moments and then subsiding. It may also be noted that, as on the 18th, some of the highest temperatures have occurred when the sky was covered with thin cirrho-stratus clouds.

Before the paper, the PRESIDENT: The lecturer of the evening, Dr. Hunter Workman, is going to address us on his last expedition with Mrs. Bullock Workman, his wife, in the Himalayas. I regret that Mrs. Workman has not been able to be here to-night, as we hoped she would have been, because she is engaged in something almost more arduous than climbing 23,000 feet. She is delivering thirty lectures in thirty-seven days, starting from Munich and going by Vienna up to Dresden, Berlin, Hamburg. I need not introduce Dr. Workman to you, because he and Mrs. Workman are old friends of our Society. It is about eight or nine years since they started on their explorations in the Himalayas. Dr. Workman delivered an address here about three years ago on his journey from Srinagar to the sources of the Chogo Lungma glacier. They then returned to the Himalayas, and in the following year Mrs. Bullock Workman gave us a very interesting address on the earliest exploration ever made of the Hoh Lumba and Sosbon glaciers. To-night, after fresh travels and always on new ground, we are to hear from Dr. Workman an account of their joint ascents in the Nun Kun group. I shall not enter into the difficult question as to what traveller has ascended the greatest height above sea-level. We have Dr. Longstaff here, and I believe there is only a matter of about 10 feet between them, him and Dr. and Mrs. Workman; but I will remind you that all of these explorers are not merely trying how high they can climb. Careful observations are taken of glaciation and in other scientific directions, so that their ascents have real scientific value.

After the paper, Sir THOMAS HILDICH: I am rather glad of this opportunity of expressing my admiration for the consistency and the determination and the ability with which a long record of observations has been taken by Dr. Hunter Workman and his gallant wife—if he will allow me the expression—under circumstances of extreme difficulty. I have had some slight acquaintance with the difficulties and the disabilities which beset the taking of observations in very high altitudes in the Himalayas, and I can only liken it to the conditions under which a man might find himself if he was at sea in very stormy weather, and very sea sick, and was asked suddenly to make records of the height of the waves and the strength of the winds: he would find that it took a great deal of resolution and determination to effect his purpose. It is indeed a most difficult proposition.

There are some of the phenomena to which Dr. Hunter Workman has referred which I had the opportunity of observing, to a certain extent, when I was in the Andes. He referred to the *nieves penitentes*. Now, although I saw nothing of *nieves penitentes* in the highest altitudes of the Andes, yet I did observe distinctly the same results, induced probably by the same causes, on the surface of the wide plains which intervene between the Andes and the Atlantic, as I was crossing in winter;

* See the *Geographical Journal*, March, 1905, p. 260.

and I was convinced that the cause of the formation which Dr. Hunter Workman puts forward is correct, namely wind-action. I know of no part of the world in which the wind is more persistent from a certain quarter than it is on the western slopes of the Andes and across the intervening plains between the Andes and the Atlantic. The *nieves penitentes* of the Pampas were most obviously caused by wind. As regards his criticism of the Survey maps, I have very little to say. I can only explain to you, as he must be very well aware, that it is not, and never can be, one of the primary objects of the Survey Department of India to make detailed maps of regions so inaccessible and so remote as those which Dr. Hunter Workman has visited. All I can certainly promise is that the department which is responsible for those maps will receive with the greatest thankfulness any corrections or recommendations that explorers of the type of Dr. Hunter Workman, who take observations carefully and consistently, may possibly give to them.

You must know, for it has been frequently discussed in this hall, the difficulty that exists in determining altitudes at such great heights as those with which Dr. Hunter Workman has been dealing. Barometric observations are notoriously uncertain, and amongst them we must include hypsometric observations, that is, observations obtained by the boiling-point of water, to which Dr. Workman has referred; all are equally affected by variations in atmospheric conditions. There is no doubt that the most certain way of determining the heights of remote and inaccessible peaks is by a process of triangulation, where the angles are actually measured and heights reduced by mathematical processes. But all the same, it must be admitted—and will be admitted by any mathematician—that even so there are uncertainties when it comes to dealing with such enormous altitudes as those of the Himalayan peaks. We do not know exactly, and at present there is no means of determining, what the exact effect of refraction may be in those altitudes; and the result of variation when applied as correction to those observed trigonometrical altitudes may be very considerable. For instance, I may mention that we are still in doubt as to the exact height of the highest mountain in the world, Mount Everest. But we are pretty certain that whatever the correction may be that has to be eventually applied when we are more certain than we are at present of the value of refraction, it will not diminish that height. On the contrary, Mount Everest will probably prove to be some hundred feet or so higher than we at present reckon it. But when we come to the mountains which approach Mount Everest nearest in height, K_2 , which is situated in the north-west of the Himalayas, and that grand peak Kinchinjunga, opposite Darjiling, we are not at present sure which is the highest. We know which is the highest peak in the world, but we do not know the second highest. It may prove—personally, I think it will so prove—that K_2 (a peak with which Dr. Hunter Workman is well acquainted), which has always been considered to be the second highest, will prove to be third, and Kinchinjunga will have the honour of ranking second.

However that may be, we must all of us accord our unmitigated admiration to the exploits of a lady who has succeeded in exploring such inaccessible altitudes as Mrs. Bullock Workman has done. My admiration for her achievements is unlimited, and I think that, even if it is impossible to say, amongst some four or five people who have ascended higher than any people in the world, which individual amongst them has actually achieved the proud position of getting highest, still we must agree that amongst those few Mrs. Bullock Workman certainly takes a prominent place. Under which circumstances, it is possible that it may be suggested to you, as it has been to me, that it is almost time that a great society like this ranked ladies and men together on precisely the same plane of geographical research. I won't pursue that subject any further; but if any

movement hereafter should ever take place which would allow ladies as Associates of the Royal Geographical Society to receive the same official recognition as men receive, all I can say is that such a movement would have no warmer supporter than myself.

Dr. T. G. LONGSTAFF: I congratulate Dr. and Mrs. Workman very heartily on the great feat they have performed. I should think that Mrs. Workman's record for altitude will never be beaten by any other lady but herself, and any one who knows what climbing at high altitudes means must appreciate the extraordinary degree of fortitude and perseverance with which she is gifted. This ascent of a peak of 23,300 feet by a lady must always rank as one of the most wonderful mountaineering exploits on record. Dr. Workman deserves the thanks of all of us for his self-sacrifice in devoting himself to photography, the results of which have given us such pleasure this evening, instead of completing the ascent, although, of course, he climbed higher than the summit of this peak in 1903.

I must also congratulate my friend Cyprien Savoye and the six Courmayeur porters on the successful accomplishment of a very arduous enterprise. One of the essentials for still higher ascents will be that the man—or lady—who makes the final climb must not be tired out by several days of load-carrying just beforehand; and this plan of having a good supply of the very best professional Alpine porters will no doubt be necessary. In my opinion, not even the Gurkha, with all his pluck, has quite the same stamina for this sort of work as the Alpine peasant, though I, for one, prefer his company.

Dr. Workman has mentioned my name in connection with the greatest altitude at which travellers have encamped, but is not correct in what he has said about me, as he will see if he reads the account of my Tibetan experiences in 1905 in the *Alpine Journal* (vol. 23, pp. 202–228). If he had read my account, he must have noticed my reference to W. H. Johnson. This gentleman, who belonged to the staff of the G.T.S. of India, and was also a Fellow of this Society, spent a night at over 22,000 feet in the Kuen Lun when surveying beyond the Changchenmo in 1864 (*J.R.G.S.*, 37, pp. 1–47; and *Proc. R.G.S.*, 11, pp. 6–14). But the question of records does not in any way detract from the wonderful feat of endurance performed by Dr. Workman and his wife in spending a night at well over 21,000 feet, after they had already spent three consecutive nights at great altitudes.

Though Dr. Workman does not exaggerate the unpleasant symptoms experienced by most people at high altitudes—indeed, he rather makes light of them—I cannot agree with him as to the improbability of the ascent of the highest mountains on the globe, provided always that a relatively easy route exists which is not barred by “questions of high imperial policy.” On the Tibetan side of Everest the snow-line probably lies above rather than below 19,000 feet. The rest must be climbed in two days, and this cannot at present be said to be an impossible performance, because both Graham's party and my own, on the final day of the ascent of the two highest mountains that have yet been climbed, were able to ascend nearly 6000 feet and get back to camp for the night. Although I believe that personally I could not climb as high as the summit of Everest, I am equally sure that there are others who can. I wish I was as sure that Englishmen will be permitted to make the attempt.

Dr. Workman's observations on the existence and formation of *nieve penitentes* and on the relative absence of terminal moraines in this part of the Himalaya, are most interesting and valuable. But in reference to the latter, it seems to me that the action of streams and landslips combine to modify such structures in the Himalaya to a much greater extent than in the Alps or Caucasus, and I have

several times been puzzled to know whether I was standing on a terminal moraine or not.

The mountaineering obstacles to the success of Dr. and Mrs. Workman's expedition have been great; the extreme steepness of the snow-alopes we have seen on the screen to-night must have frequently subjected them to serious risks from avalanches. I think that the difficulties, and indeed the actual hardships, that are involved in taking photographs and observations at high altitudes, are realized by very few, either of the general public or scientific geographers, and I again congratulate them most heartily on what they have done, and I hope that they will be thoroughly successful in the expedition which I hear they are undertaking next year, and that Mrs. Workman will raise her own record still higher.

Dr. HUNTER WORKMAN: In regard to the case with which Mount Everest can be climbed, granting that any one might climb 7000 feet on Mount Everest, from 15,000 feet to 23,000 feet, I think the next 6000, from 23,000 to 29,000, would be a much more difficult affair, because the air is very much more rare the higher you go, and I doubt whether anybody could breathe and undergo the physical strain necessary to climb that last 6000 feet, even if he had the strength. With regard to the suggestion of mountaineers having their camps prepared for them by porters, the question is whether porters could do the work. For reasons given in the paper, I doubt it. As a matter of fact, if the ascent of Mount Everest should be attempted, it is more than likely that its gradients and the natural obstacles would be found to be such as would preclude the possibility of climbing 7000 or 6000 feet in a single day, and a succession of camps would have to be made under the disadvantageous conditions I have mentioned.

The PRESIDENT: In thanking Dr. Hunter Workman for his paper, I need not, I think, say anything more than Sir Thomas Holdich and Dr. Longstaff have said concerning our admiration for the work of himself and Mrs. Workman. I would only ask Dr. Workman to convey this to Mrs. Workman on our behalf.

BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.*

Under the Direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and
LAURENCE PULLAR, F.R.S.E.

PART XIII.—LOCHS OF THE NESS BASIN.

THIRD PART.

THE first part of this paper, published in July last, dealt with the physical features of Loch Ness, and the second part, published in October, dealt with twenty-seven of the tributary lochs. This third part includes the descriptions of the remaining five lochs, with summary

* Maps, p. 132. The admirable maps which accompany the three parts of the Ness paper (the last of the series) have been presented by Sir John Murray and Mr. Laurence Pullar, and it is thus due to their liberality that we are able to publish them free of any cost to the Society. Though this is the final contribution to appear in the *Journal*, the remaining smaller Scottish lochs are to be dealt with in a special publication to be issued, it is hoped, during this year.—PRESIDENT R.G.S.

table giving particulars of the lochs within the Ness basin sounded by the Lake Survey, to which are appended notes on: I. The temperature of the water in Loch Ness, with a footnote on the chemical composition of the water; II. the seiches of Loch Ness; III. the deposits of Loch Ness; IV. mirages on Loch Ness; V. "storm-weather" at Fort Augustus; VI. the geology of the Ness district; VII. the biology of the lochs in the Ness basin; and VIII. the aquatic vegetation of the lochs in the Ness basin.

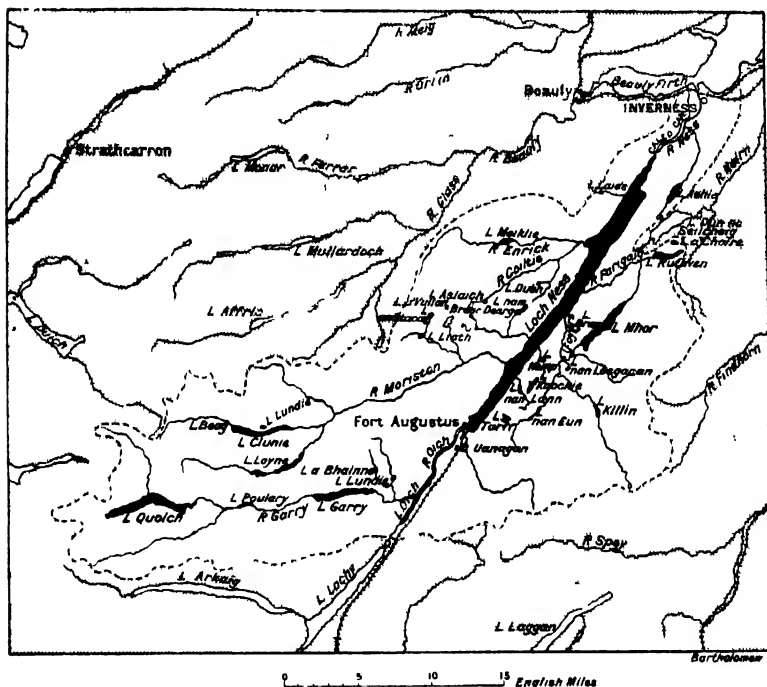


FIG. 1.—INDEX MAP OF THE NESS BASIN.

Loch Mhor (see Plate XIV.).—Loch Mhor is the reservoir for the British Aluminium Co.'s works at Foyers. In its construction advantage was taken of two natural lochs (Garth and Farraline). By means of the dam at the lower end of Loch Garth, the surface of Loch Mhor may be raised to 20 feet above the original level of Loch Farraline, the upper loch. In summer the two lochs may subside to their original levels. The loch is still divided into two portions by a causeway 2 miles from the upper end, and a public road here crosses by a bridge, the water passing by a canal underneath. The loch is rapidly forming a beach by eating away the boulder clay of the fields. These raw cliffs of clay are

exposed when the loch is below its high level, and portions are continually falling in.

Loch Mhor is of very irregular form, narrow and elongate, running north-east and south-west in Strath Errick, the lower end some 2 miles south-east of Foyers. On the west the country is moorland, with low hills, and many patches of trees on the shore of the loch. On the east the hills are higher, rising to mountains at the distance of a few miles. The west shore-line is of a simple outline, with slight double sigmoid curvature. The east shore is much broken up, several bays and arms



FIG 2 —LOCH MHOR, SOUTH WEST END, SHOWING THE SHORE WHEN THE WATER IS LOW, WITH REMAINS OF DEAD TREES

(Photo by G West From Proc Roy. Soc Edin., by permission of the Council)

running south-eastward. The largest of these is in the middle of the loch, and runs three quarters of a mile inland.

The loch is nearly 5 miles in length, has a maximum breadth of nearly three-quarters of a mile, and a mean breadth of one-third of a mile. It has a superficial area of $1\frac{1}{2}$ square miles. The volume of water is subject to great variation, being estimated at the date of the survey (April 24 and 25, 1903) at 1134 millions of cubic feet. It drains an area of about 21 square miles. Few streams of any importance enter the loch. The largest are the Allt na Seabhaig, which formerly flowed into the river Gourag, but was diverted into Loch Garth when the dam was built, and the Aberchalder burn, which enters the large middle bay on the east. When quite full the reservoir overflows into the Gourag. When surveyed the surface was 638.5 feet above sea-level. In accordance

with its artificial origin, the greater part of Loch Mhor is very shallow; deep water is only found in the original natural lochs. Two-thirds of the whole area is less than 25 feet deep.

The basin formed by Loch Farraline before the surface was raised was fully a mile in length, and one-third of a mile broad, with a depth of about 40 feet. The breadth has been very little increased by the dam. The depth is now 60 feet. The basin is simple, with uniform contours and gently sloping sides. The 25-foot contour encloses an area of two-thirds of a mile long by one-fifth of a mile broad. The



FIG 8 — LOCH MHOR, SOUTH-EAST SHORE, WHEN THE WATER IS LOW, ROCKS THAT HAVE BEEN DENUDED OF THEIR PEAT COVERING EXHIBIT GLACIAL STRIATION.

(Photo by G West From 'Proc Roy Soc Edin', by permission of the Council)

50-foot area is very narrow, a quarter of a mile long, and a little east of the central line.

The basin of Loch Garth, which was $1\frac{1}{2}$ miles long by nearly half a mile broad, is of irregular shape. The main part of the loch was oblong, but a long, curved, narrower part branched off to the south. The depth is now 91 feet (the maximum for Loch Mhor). The 25-foot contour almost coincides with the shore-line of the original loch. The 50-foot contour encloses an area $1\frac{1}{4}$ miles in length, and enters the narrow southern branch. This area is broad for half a mile at the north end, but from there south it is a narrow channel. The 75-foot area is one-third of a mile long by one-fifth of a mile broad. The mean depth of the whole loch is 24 feet.

Series of temperatures were taken in Loch Garth on April 24, and in

Loch Farraline on April 25. The higher temperature of Loch Farraline might be due merely to its being taken a day later, as the weather was warm.

				<i>Loch Garth, April 24,</i>		<i>Loch Farraline, April 25,</i>	
				1903.		1903.	
Surface	...	...	...	42°·0 Fahr.	...	...	43°·5 Fahr.
10 feet	...	...	...	41°·8	...	...	43°·2
25 "	...	...	...	—	"	...	43°·0
30 "	...	...	...	—	"	...	42°·4
40 "	...	...	...	41°·2	"	...	42°·0
55 "	...	...	...	—	"	...	42°·0
80 "	...	...	...	41°·2	"	...	—

Loch Bran (see Plate I.).—Loch Bran is situated in the woods above Foyers, from which it is a mile distant. The shores are wooded, with rock showing in places a little way from the water's edge. There are really two basins at the same level, separated by a narrow neck of land. The loch is very narrow, with the centre line strongly curved. Its length, measured in a straight line, is about three-eighths of a mile, measured round the curve nearly three-quarters of a mile; the maximum breadth is one-fifth of a mile. The superficial area is about 24 acres, and the volume of water 13 millions of cubic feet. The drainage area is only a quarter of a square mile; the loch receives no streams of any size. The east loch drains into the west loch, and that into the river Foyers by a burn half a mile long. The east loch is much the larger and deeper, but the deep area with a maximum of 50 feet is only a little hole in the middle of the loch. The greatest depth in the west loch is 19 feet. The mean depth of the whole loch is $12\frac{1}{2}$ feet. The temperature at the surface on April 30, 1903, was 48°·6 Fahr.; at 10 feet, 46°·2; at 20 feet, 45°·0; at 25 feet, 42°·3; and at 50 feet, 42°·2.

Loch a' Choire (see Plate XV.).—A little loch lying between Lochs Duntelchaig and Ruthven, and draining into the latter. Low but craggy hills border the loch on the west and north, the crags of Creag Dearg facing the west end. The loch is of somewhat oblong form, with the long diameter east and west. The length is nearly two-thirds of a mile, the greatest breadth one-third of a mile, the mean breadth one-fifth of a mile. The superficial area is about 86 acres, and the volume of water 103 millions of cubic feet. The drainage area is nearly one square mile. Only one stream, the Allt Bhreac, flows in on the north, and at the east end the burn flows out towards Loch Ruthven.

Loch a' Choire is 865 feet above the sea. The bottom forms a simple basin, with the deeper water towards the east end. The 25-foot contour follows the shore-line, except at one point on the north where a sounding of 18 feet lies far out. The 50-foot area, one-sixth of a mile in length, lies all to the east of the centre of the loch. The maximum depth is 60

feet, and the mean depth $27\frac{1}{2}$ feet. The temperature at the surface on April 28, 1903, was $43^{\circ}\cdot 5$ Fahr.; at 25 feet, $42^{\circ}\cdot 5$; and at 50 feet, $42^{\circ}\cdot 5$.



FIG. 4 —WEST END OF LOCH RUTHVEN, LOOKING EAST.

(Photo. by G West From '*Proc Roy Soc Edin.*,' by permission of the Council.)

Loch Ruthven (see Plate XV.). —A loch of fair size, some $2\frac{1}{2}$ miles east of Loch Ness, opposite Urquhart bay, and half a mile south of Loch Duntelohaig. It is a narrow loch, with its central line much curved, but having its general direction east to west. Precipitous wooded hills, the Tòrr Mòr and the Torr Beag, rise abruptly from the north shore. On the south the crags of Stac Gorm and Craig Ruthven border the eastern part of the loch, while towards the west the ground is lower and more open.

Loch Ruthven is very narrow in the middle, slightly expanded at the east, and much expanded at the west end. The length is $2\frac{1}{2}$ miles, the maximum breadth, close to the lower end, fully half a mile, and the mean breadth a quarter of a mile. It has a superficial area of about 368 acres, or over half a square mile, and a volume of 180 millions of cubic feet. The drainage area is 4 square miles. The burn from Loch a' Choire comes in near the upper end of the loch, and there are no other burns of any size. The outflowing stream is the river Farigaig, which falls into Loch Ness at Inverfarigaig.

When surveyed on April 27 and 28, 1903, the loch was 2 feet below a bench-mark, 703·1 on the south shore at the upper end, and would therefore be 701·1 feet above the sea. This figure is at variance with

two spot-levels on the north shore where 687 and 688 feet are marked near the west end, and there is no dam to account for so much difference. The Ordnance Survey, on May 8, 1871, made the level 700·4 feet, only a few inches lower than our measurement. Loch Ruthven is on the whole very shallow, having a mean depth of only 11 feet. The small eastern expansion has a flattish sandy bottom, with a greatest depth of 8 feet.

The narrow part, a mile in length, has a uniform central depth of 14 feet throughout, but in it, just three-quarters of a mile from the upper end of the loch, is an abrupt little hole of very limited extent, where the maximum depth of 42 feet occurs. The western basin has a flattish bottom, with a depth of about 13 feet, and two little depressions of 20 and 25 feet. Rock is exposed on the north shore at the bases of the Torrs, and at several points on the south shore. Though the rock is near all along the south shore, the beach is for the most part of gravel and boulders. The river flows out through a grassy flat.

The temperature on April 27, 1903, was 45°·0 Fahr. from top to bottom, and the air at the time was also 45°·0.

Loch Ashie (see Plate II.).—Loch Ashie is used for the water-supply for the town of Inverness. It is about 6 miles south of the town, and 1½ miles east of Dore, on Loch Ness. It is an elongate loch of moderate size, having the same general direction as the Great Glen. The west



FIG. 5.—LOCH ASHIE FROM THE NORTH-EAST, LOOKING SOUTH-WEST, SHOWING BARREN FLAT AND STONY SHORE.

(Photo. by G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.)

shore is bordered for its whole length by Drumashie wood; on the east is a bare woodland stretch little higher than the loch.

Loch Ashie is $1\frac{1}{2}$ miles in length. It is nearly half a mile broad in the middle, and narrows towards each end. The mean breadth is one-third of a mile. Its superficial area is half a square mile, and the volume of its water 309 millions of cubic feet. It has a drainage area of nearly 3 square miles. Only a few very small burns go into it, and the Allt Mor, its natural outflow at the north end, flows into the river Ness 2 miles above the town of Inverness.

Loch Ashie forms a simple basin, with all the contours following the line of the shore, and the sides everywhere with a uniform gentle slope. The maximum depth of 51 feet is in the centre of the loch. The mean depth is 21 feet.

The surface on April 14, 1903, was 717·75 feet above sea-level, the water just lipping the sill of the sluice at the north end; the Ordnance Survey, on April 6, 1871, found the level to be 716·0 feet above the sea. On the date of the survey the temperature from surface to bottom was 41°·8 Fahr., the air temperature at the same time being 36°·0.

The details regarding the lochs in the Ness basin are collected together in the table on the following pages for convenience of reference and comparison.

From this table it will be seen that in the thirty-three lochs about 4400 soundings were taken, and that the aggregate area of the water-surface is $34\frac{1}{2}$ square miles, so that the average number of soundings per square mile of surface is 128. The aggregate volume of water contained in the lochs is estimated at 280,923 millions of cubic feet, or less than 2 cubic miles. The area drained by these lochs is about 690 square miles, or twenty times the area of the lochs.

APPENDICES.

I.

NOTES ON THE TEMPERATURE OF THE WATER* IN LOCH NESS.

By E. M. WEDDERBURN, W.S., LL.B.

REGULAR temperature observations in Loch Ness were begun at Fort Augustus in July, 1903, at the same time as the first limnograph to be used in Scotland was erected. At first the temperature observations were subsidiary to the other observations made in the loch, but gradually their importance increased until the

* The water of Loch Ness was submitted to analysis by Dr. Tetlow, who found nothing abnormal about the water, except its softness and freedom from mineral matter, the total solids being equal to only 2·9224 parts per 100,000 (1·9012 parts of fixed solids, and 1·0212 parts of volatile solids); the principal constituents are sodium and calcium chlorides, while magnesium chloride, iron, potassium, silicon, carbonic acid, and sulphuric acid are present in traces.

BATHYMETRICAL SURVEY OF

SUMMARY TABLE.

Giving Details concerning the Lochs within the Ness Basin.

Loch.	Height above sea. Feet.	Number of sound- ings.	Breadth in miles.			Depth.		Ratio of depth to length.		Volume in million cubic feet.	Area in square miles.	Drainage area.	
			Max.	Mean.	per cent. of length.	Max. Feet.	Mean Feet.	Mean.	Max.			Total in square miles.	Ratio to area of loch.
Ness ...	52.60	1633	1.96	0.90	3.7	754	433.02	170	295	263,162	21.78	686.31	31.6
Quoch	556.00	280	0.80	0.43	6.1	281	104.60	131	331	8,345	2.86	49.18	17.2
Poullary	[320 approx.]	37	0.20	0.10	6.7	47	9.90	21.0	164	779	39	82.18	587.0
Garry	257.00	272	0.90	0.56	7.3	213	78.00	36.6	121	332	3,794	137.33	78.5
a' Bhainne ...	[1060 approx.]	42	0.36	0.26	0.14	38.9	28	9.69	34.6	196	14	1.81	86.2
Lundie (Garry)	443.40	103	0.76	0.40	0.22	29.6	16.28	30.1	74	246	78	3.44	20.2
	[Aug. 18, 1869]												
Oich ...	106.00	195	0.30	0.19	4.7	154	41.78	27.1	138	509	0.76	170.96	224.9
Uanegan	118.20	56	0.52	0.12	0.07	13.5	4.3	16.80	39.1	163	18	1.21	30.2
Beag ...	605.20	27	0.30	0.22	0.13	43.3	29	11.80	47.2	63	13	0.04	510.0
Clunie	605.20	126	4.28	0.50	0.26	6.0	123	49.98	40.6	184	1.533	32.29	29.3
Lundie (Clunie)	681.50	28	0.46	0.18	0.09	19.6	25	7.80	31.2	311	9	0.95	23.8
West Loch Loyne	719.00	67	1.28	0.34	0.19	14.7	19	5.93	31.2	356	40	16.21	67.6
East Loch Loyne	706.10	123	2.75	0.30	0.15	5.6	35	10.32	29.5	415	123	23.87	55.5
An Slaca	[1600 approx.]	85	1.02	0.40	0.25	24.5	51	15.52	30.4	106	37	1.23	4.8
Liath...	1494.10	43	0.46	0.28	0.21	45.0	35	22.36	40.7	44	62	4.00	40.0
Nam Breac Dearga	[1570 approx.]	60	0.74	0.21	0.12	16.0	70	24.43	34.9	56	60	0.60	6.7
a' Vullan	[1750 approx.]	38	0.45	0.18	0.09	21.6	27	12.27	45.4	88	15	0.69	17.2
Meikle	364.90	49	1.10	0.43	0.28	25.9	45	22.10	49.1	129	263	41.32	133.3
Alaich	[1310 approx.]	38	0.35	0.14	0.09	26.9	26	10.91	42.0	71	169	1.62	54.0
Dubb	[1340 approx.]	20	0.18	0.11	0.07	38.9	7.00	38.9	53	136	2	0.01	17.0

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* With the exception of Loch Ashie, the drainage areas of all the lochs are included in that of Loch Ness.

investigation of lake-temperatures became one of the principal studies of members of the Lake Survey stationed on Loch Ness. The observations were originally made from a rowing-boat by means of the Pullar and Lucas sounding machines and deep-sea reversing thermometers. An endeavour was made to take the observations at regular hours in as nearly as possible the same positions in the loch from day to day, but in stormy weather the keeping of the same position during lengthy observations was attended with considerable difficulty. In September, however, a small decked fishing-boat, called the *Rhoda*, was anchored off Fort Augustus in about 300 feet of water. The anchoring of this boat caused some anxiety, but it was ultimately accomplished by means of a large mushroom anchor, which, with the necessary length of chain, was put at the disposal of Sir John Murray through the courtesy of Mr. Davidson, superintendent of the Caledonian canal.

This boat was primarily intended to accommodate the electrical thermometers which were installed, but it came to be very largely used for taking observations by means of mercury thermometers. Lengthy series of observations could be taken in comfort whatever the state of the weather, and with great economy in time. It was possible to use three or four sounding machines and thermometers at once, and consequently a series of observations could be made much more expeditiously than when only one sounding machine was used.

The electrical thermometers were at first intended to furnish the means of observing continuously radiation into and from the loch. The apparatus was not altogether suitable for this purpose, and, being the first installation of its kind in this country, many unforeseen difficulties arose in the manipulation of the instruments, but nevertheless many valuable observations were made by its means. The installation consisted of three platinum resistance thermometers and a Callendar recorder. The boat-house of St. Benedict's Abbey was made available to the Lake Survey by the Lord Abbot of the monastery, and in it were placed the recording instruments. A four-ply cable connected the recorder with the *Rhoda*, which was anchored at a distance of about 300 yards from the boat-house. Many of the difficulties which were experienced arose from this cable; the strain of the wind and the waves was constantly damaging it, and as the *Rhoda* swung round with the wind great care was necessary to prevent the cable fouling with the anchor chain. On the *Rhoda* there were three large drums, on which were wound the leads for the resistance thermometers. By these drums a thermometer could be lowered to any desired depth, and then connected to the shore-cable by means of mercury cup connections, and a continuous record of the temperature at that depth could thus be obtained. It was intended to lower each of the three thermometers to a different depth, and connect them successively with the recorder, and so to get a series of readings at these depths, but the sluggishness of the recorder made this method of observation undesirable.

Temperature observations were taken at various points along Loch Ness. At times members of the survey were stationed at Invermoriston, Foyers, Inverfarigaig, Whitefield, and Dores. At other times a steam-launch was chartered, and cruises made up and down the loch, taking observations *en route*, but this method of observation was very slow. The speed of the launch was about 6 miles an hour, and, as the loch is 24 miles in length, about eight hours were spent in steaming alone; assuming that six series of observations were taken, each lasting over half an hour, the observations at one end of the loch were taken six or seven hours later than at the other end. It was found that in this time the distribution of temperature in the loch might alter very greatly, and therefore observations made in this manner might give a very erroneous idea of that distribution.

The observations in Loch Ness were discontinued by members of the Lake

Survey in September, 1904, but the work was taken over by the monks at Fort Augustus (in particular by Father Cyril von Dieckhoff and Father Odo Blundell), and continued by them until April, 1905, so that the observations extend over a period of nearly two years. The actual number of observations made in that time was about 12,000, and these have been discussed by the writer in papers communicated to the Royal Society of Edinburgh.* The results arrived at are briefly as follows:—

The yearly cycle of changes in a loch such as Loch Ness is very much the same from year to year. Fig. 6 shows graphically what may be called the typical curves for each month of the year, being drawn from the monthly means of the temperature readings during the period of the observations. From these curves it appears that in September there is the greatest quantity of heat in the loch. Thereafter the loch cools gradually till March or April, when the water again begins to gain heat. This is the time when the mean air-temperature begins to be higher than the surface temperature. From May till August the increase in temperature at various depths proceeds regularly, and the typical curves representing the temperature of the water to a depth of 200 feet are practically straight lines. Below that depth it is probable that the temperature increases less rapidly in proportion to the depth, but even in the deepest waters of Loch Ness there is a range in temperature of about 2° Fahr. The lowest recorded temperatures in the deepest parts of the loch are in April, and the highest in the middle of November. During the period in which the loch gains heat, the most remarkable changes are those taking place at and near the surface. Rapid changes are of frequent occurrence, and are probably due to convection currents. On one occasion the temperature at the point of observation rose 6° Fahr. in two minutes.

When the mean air-temperature falls below the surface temperature, which is usually in August, the loch begins to part with its heat. This is shown in the change of type in the typical curve for September. The surface layers lose heat, while lower down the water still continues to rise in temperature; as already mentioned, the highest temperature at 700 feet was observed in November, or about three months after the loch began to lose heat. In August the discontinuity between the upper and lower layers of the loch usually becomes well marked. As the upper layers of water become colder, there is a layer at the surface of nearly uniform temperature, and of gradually increasing depth. Below this layer there is a sudden change of temperature—a discontinuity-layer—below which there is the colder water in the loch. As the season advances this discontinuity-layer gradually sinks lower, and the layer of uniform temperature above it increases in depth, until finally the whole loch is of nearly uniform temperature.

Before the discontinuity-layer makes its appearance, the currents produced by winds are distributed through the whole loch. There is the surface current, directly produced by the wind, carrying the warm surface water along with it, and the return current, to take the place of the water blown along the loch, is spread throughout the whole depth of the loch. But when the discontinuity-layer has formed, the loch is divided into two current systems. Above the discontinuity-layer there is the surface current produced by the wind, and the return current also takes place above the discontinuity-layer, without directly affecting the deeper waters.

* "The Temperature of the Fresh-water Lochs of Scotland, with special reference to Loch Ness, with an appendix containing observations made in Loch Ness by members of the Scottish Lake Survey," *Trans. Roy. Soc. Edin.*, vol. 45, p. 407 (1907); "An Experimental Investigation of the Temperature Changes occurring in Fresh-water Lochs," *Proc. Roy. Soc. Edin.*, vol. 27, p. 2 (1907).

This return current, however, acts on the water below the discontinuity-layer just as the current of wind acts on the natural surface of the loch, and a secondary current is produced at the surface of discontinuity. This secondary surface current is much slower than the surface current produced by the winds, but to take the place

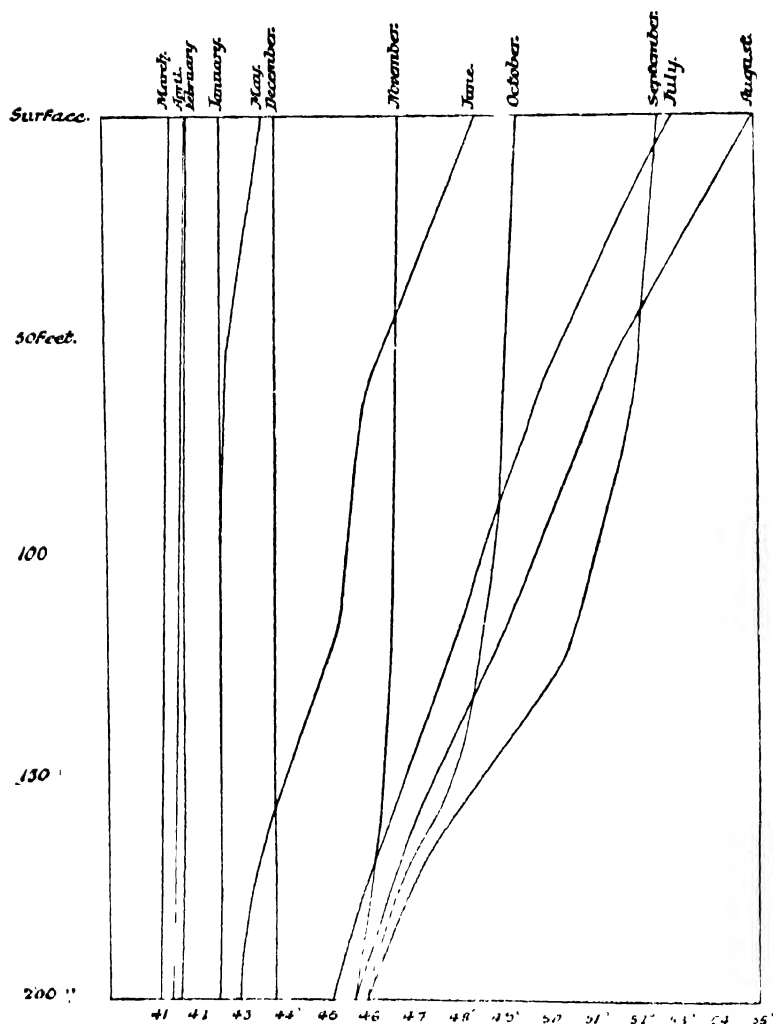


FIG. 6.—TYPICAL MONTHLY CURVES OF TEMPERATURE IN LOCH NESS.

of the water carried along by it, there is a secondary return current at the bottom of the lake. The secondary return current is very slow, and its existence was first suggested to the writer by experiments carried out in a glass trough, but observations support the view taken. The current systems thus described are shown in Fig. 7.

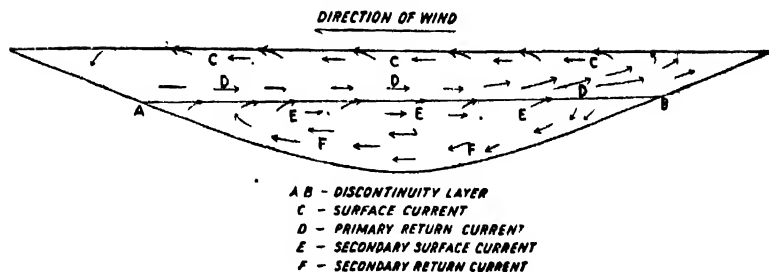


FIG. 7.—CURRENT SYSTEMS IN A LOCH INDUCED BY WIND AT THE SURFACE.

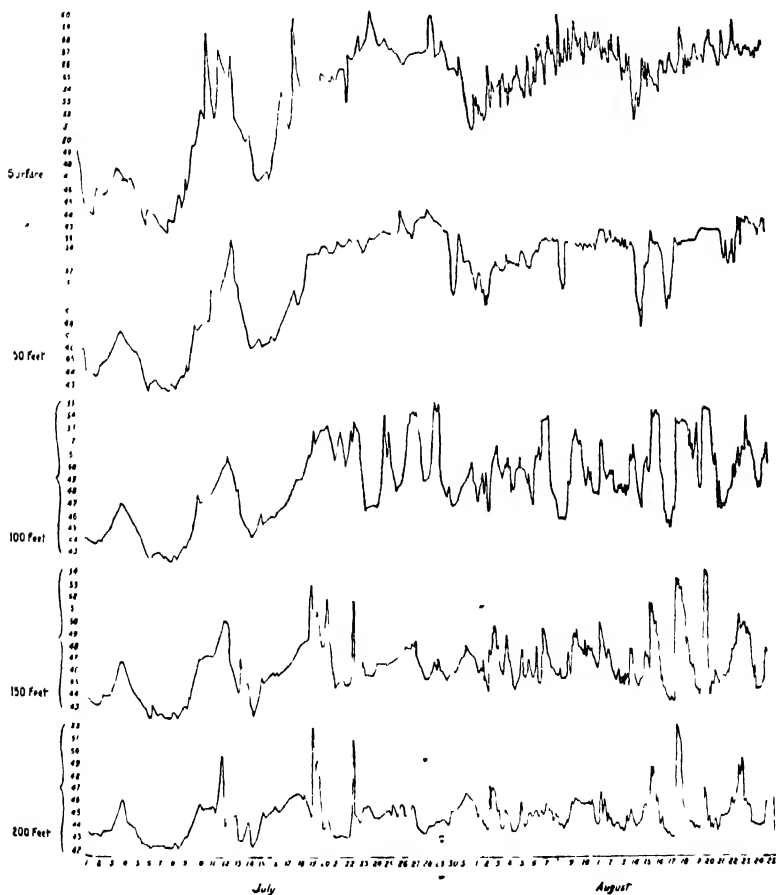


FIG. 8.—TEMPERATURE VARIATIONS IN LOCH NESS AT FORT AUGUSTUS DURING JULY AND AUGUST, 1904.

Another effect of the separation of the loch into two compartments by the surface of discontinuity, is to render possible the temperature seiche. The surface current produced by the wind transfers a large quantity of warm water to the lee end of the loch, with the result that the surface of discontinuity is deeper at the lee than at the windward end of the loch. When the wind moderates or ceases a temperature seiche is started, just as a seiche is started in a basin of water which has been tilted. The temperature seiche was also studied experimentally, and was made visible by superimposing a layer of paraffin on a layer of water. By driving the paraffin to one end of the trough by a current of air, the water, corresponding to the water below the surface of discontinuity in a loch, received a tilt, and when the current of air was stopped, a seiche started in the lower layer of water independently of the upper layer of paraffin.

The temperature seiche was first described by Mr. E. R. Watson in the autumn of 1903, and a good deal of doubt was expressed as to the accuracy of his views, but the theory of a temperature seiche was established by the observations taken in 1904. For a considerable period observations were taken at Fort Augustus every two hours, so as to obtain a continuous record of temperature. Fig. 8 is drawn from the observations taken in July and August, 1904, and shows the temperature variations at Fort Augustus at the surface and at depths of 50, 100, 150, and 200 feet. It will be observed that in July changes at the surface, which are chiefly produced by winds, are accompanied by similar changes at all depths, but that in August, when the discontinuity-layer has been formed, the temperature variations at the surface are independent of the variations at a depth of 100 feet, where the variations are principally due to the temperature seiche.

Observations made at the two ends of the loch further support the theory, as showing that the layer of discontinuity was in general rising at one end when it was falling at the other end. Continuous records obtained from the Callendar recorder are also easily explained by the temperature seiche. Rough calculations were made of what should be the period of this seiche, based on the assumption that the loch contained two layers of waters of different but uniform density. The observed period varied with the time of year, according to the depth of the discontinuity-layer, and was from two to three days, which agrees remarkably with the periods obtained by calculation.

II.

NOTES ON THE SEICHES OF LOCH NESS.

By E. M. WEDDERBURN, W.S., LL.B.

In June, 1903, observations on seiches were begun in Loch Ness by the erection of a Sarasin limnograph in the boat-house of St. Benedict's Abbey, Fort Augustus. This instrument worked well during the period it was in use, and some good records of seiches were obtained. The largest seiche recorded by it occurred on November 21, 1903, and had an amplitude of about $4\frac{1}{2}$ inches, but after about two days it was disturbed by the starting of another seiche.

In the summer of the succeeding year a second Sarasin limnograph was erected at Inverfargaig, but it did not work satisfactorily—perhaps owing to the exposed situation—and the records obtained were consequently not looked upon as being entirely trustworthy, although, as was to be expected, they pointed to a node in the neighbourhood of Inverfargaig.

Observations were also made by means of Forel's plemyrrometer, but owing to

the exposed character of the shore all along Loch Ness, observation by this means was very difficult. It is unfortunate that the index limnograph subsequently used by Prof. Chrystal had not been designed while work was being carried on in Loch Ness.

The observed periods of the uninodal and binodal seiches in Loch Ness are approximately 31.5 and 15.3 minutes respectively. Loch Ness thus belongs to that class of basins, in which the period of the binodal seiche is less than half the period of the uninodal seiche. The periods for Loch Ness have not been calculated according to Chrystal's theory—an exceedingly laborious piece of work, which it is hoped will yet be undertaken—but the writer has every reason to believe that calculation would agree with observation in this case also. For the basin of Loch Ness is convex at Foyers, where the floor of the loch rises some 200 feet, and, moreover, the sudden shallowing which takes place in the loch from Dores to Bona has the effect of increasing the ratio between the periods of the uninodal and binodal seiches. This is seen in the Lake of Geneva, where there is also a shallowing at one end of the lake, and where the period of the uninodal seiche is more than double the period of the binodal seiche.

Seiches of shorter period were also of frequent occurrence, notably a seiche with a period of about 8.8 minutes, of which some remarkably pure records were obtained, although they were of small amplitude.

Embroideries on the curves were common, and were attributed to a long swell on the loch, to the wash of steamers, and frequently to the opening of lock-gates on the canal at Fort Augustus.

With the view of gaining information on the effect of small variations in atmospheric pressure, a Dines's sensitive barograph was obtained.* Records from an ordinary Richard barograph had indicated sudden barometric changes as a frequent cause of seiches, and the records of the sensitive barograph supported this view to a certain extent, although on some occasions the loch seemed unresponsive to changes in atmospheric pressure. On other occasions, however, the limnograph record seemed to be an accurate reproduction of the record obtained by means of the sensitive barograph.

Loch Ness from its size proved to be rather unwieldy from the point of view of seiches, so that when, in the summer of 1905, the investigation of seiches was undertaken by Prof. Chrystal, he made his headquarters on Loch Earn, and gathered much information as to the cause of seiches from his observations.†

* The purchase of this instrument was facilitated by a grant from the Murray Bequest to the University of Edinburgh.

† For further details the reader is referred to the following papers:—"On the Hydrodynamical Theory of Seiches, with a Bibliographical Sketch," by Prof. Chrystal, *Trans. Roy. Soc. Edin.*, vol. 41, p. 599 (1905); "Calculation of the Periods and Nodes of Lochs Earn and Treig, from the Bathymetric Data of the Scottish Lake Survey," by Prof. Chrystal and E. M. Wedderburn, *Trans. Roy. Soc. Edin.*, vol. 41, p. 823 (1905); "An Investigation of the Seiches of Loch Earn by the Scottish Lake Survey": Part I. "Limnographic Instruments and Methods of Observation," by Prof. G. Chrystal; Part II. "Preliminary Limnographic Observations on Loch Earn," by James Murray, *Trans. Roy. Soc. Edin.*, vol. 45, p. 361 (1906).

III.

NOTES ON THE DEPOSITS OF LOCH NESS.

By G. W. LEE, D.Sc., and L. W. COLLET, D.Sc., with Analyses of
Selected Samples by A. WILSON, F.I.C.

ABOUT sixty samples of the deposits covering the floor of Loch Ness were collected by the members of the Lake Survey staff from various parts of the loch, and were examined according to the methods used in the *Challenger* Office for the study of marine deposits.

They may be classed as follows:—

- (1) *Dark grey mud*, from the deep basin opposite Urquhart bay;
- (2) *Ferruginous mud*, from the part of the Invermoriston deep basin opposite Horseshoe craig;
- (3) *Peaty mud*, from the south-west end of the Invermoriston deep basin;
- (4) *Yellow-grey clay*, from off Inverfarigaig and off Cherry island; and
- (5) *Brown sand*, from shallow water off Urquhart bay.

(1) DARK GREY MUD.

The eleven samples of this mud are homogeneous and coherent when dry. A typical sample from 740 feet, opposite Urquhart bay, has the following mineralogical composition:—

Minerals (25 per cent.), mean diameter 0·1 millimetre. Of these particles quartz is the most abundant, often coloured red by a coating of iron oxide. Orthoclase, chloritic minerals, and limonite are also present.

Fine washings (75 per cent.), composed of vegetable matter (15·89 per cent.) and clayey matter (59·11 per cent.), with fine mineral particles and limonitic matter.

Chemical Composition

Total silica	...	...	...	...	...	...	62·86
Ferric oxide	..	..	..	..	..	..	12·27
Alumina	.	.	..	..	.	..	9·38
Lime	...	...	...	...	...	...	tr.
Magnesia	...	...	.	..	...	...	tr.
Loss on ignition	...	...	...	...	...	...	15·89
							<hr/> 99·90

The high percentage of silica is due to the great proportion of quartz. The alumina is due to the presence of felspar and clayey matter. The defect 0·10 per cent. is probably due to the fact that the alkalies have not been estimated.

(2) FERRUGINEOUS MUD.

This type of sediment is limited to the part of the Invermoriston deep basin opposite Horseshoe craig. One of the samples was found after examination to be composed of:—

Minerals (29 per cent.), essentially represented by ferruginous grains, which are accompanied by quartz, orthoclase, chlorite, and hornblende. These mineral particles are angular, and have a mean diameter of 0·12 millimetre.

Fine washings (71 per cent.), composed of vegetable matter (18·46 per cent.) and fine minerals (52·54 per cent.), belonging to the species mentioned above.

Chemical Composition.

Chemical Composition.						
Total silica	...	..	...	...	...	37.44
Ferric oxide	.	...	...	...	...	24.48
Alumina	.	...	...	...	...	15.12
Lime	...	.	...	...	...	2.16
Magnesia	..	.	...	...	...	1.80
Loss on ignition	...		...	...	...	18.46
						<hr/> 99.46

The defect 0.54 per cent. is to be sought for in the alkalis.

As there is no clayey matter in this sediment, and as the microscopical investigation did not reveal the presence of many aluminous minerals, the high percentage of alumina, *i.e.* 15.12 per cent., is to be explained by the fact that the ferruginous grains are not made up of pure iron oxide, but of a mixture of this oxide with clay.

Although manganese was not estimated in the above quantitative analysis, it was found to be rather abundant in another sample.

(3) PEATY MUD.

This type of mud occupies a large area of the floor of the loch in the south-west end of the Invermoriston deep basin.

In order to show the differences in composition due to increase of depth, two descriptions will be given here.

First Sample. Depth 300 feet.

Minerals (35 per cent.), angular, mean diameter 0.2 mm.: orthoclase and acid plagioclase, greenish chlorite in large flakes, quartz, hornblende, and ferruginous matter.

Fine washings (65 per cent.), composed of vegetable matter (37.10 per cent.) and mineral particles (27.90 per cent.) belonging to the above-mentioned species.

Chemical Composition.

Total silica	...	...	...	...	...	...	47.88
Ferric oxide	.	.	...	...	...	...	5.58
Alumina	...	..	.	...	.	...	7.02
Lime	...	...	...	.	...	...	1.08
Magnesium	...	...	...	...	...	...	0.59
Loss on ignition	..	...	...	...	...	...	37.10
							<hr/> 99.25

Second Sample. Depth 445 feet.

Minerals (10 per cent.), angular, mean diameter 0.12 mm.: orthoclase and acid plagioclase, quartz, chlorite, hornblende, and ferruginous matter.

Fine washings (90 per cent.), composed of vegetable matter (25 per cent.) and fine mineral particles (65 per cent.) of the same species as those mentioned under the heading: minerals, but chlorite and decomposed felspar are relatively more abundant.

Chemical Composition.

Total silica	...	...	...	...	...	...	46.03
Ferric oxide	.	...	..	..	..	..	10.41
Alumina	.	.	..	.	.	...	7.61
Lime	...			.	.	..	9.64
Magnesia	.	.	.	.	.	..	1.60
Loss on ignition			.			..	24.65
							<hr/> 99.94

Comparing the results of the investigation of these two samples, it will be seen that as the depth increases both the percentage and the diameter of the minerals decrease, the proportion of vegetable matter also decreasing.

The high percentage of lime in the second analysis is probably due to fragments of shells.

(4) YELLOW-GREY CLAY.

One sample was taken off Cherry island in 95 feet, and eight samples off the south-east coast, east of Inverfargigaig, in 250 feet. This is very clayey in character, being soft to the touch and plastic when wet, coherent when dried, and taking in the latter state a light brown streak if rubbed with a hard smooth body.

The Cherry island sample is made up of—

Minerals (1 per cent.), angular, mean diameter 0.1 mm.: quartz, orthoclase, chlorite, and ferruginous matter.

Fine washings (99 per cent.), composed of clay and very fine mineral particles

Chemical Composition.

Total silica	..	...	...	...	...	...	58.42
Ferric oxide	...	...	...	...	..	.	9.51
Alumina	...	...	...	..	...	...	24.58
Lime	...	...	...	...	..	...	0.52
Magnesia	...	...	...	...	..	...	3.74
Manganese	...	...	..	...	...	.	2.11
Copper oxide	..	...	..	...	..	...	0.65
Loss on ignition	...	..	...	..	...	...	0.59
							<hr/>
							100.12

One of the eight other samples is made up of—

Minerals (29 per cent.), angular, mean diameter 0.1 mm.: quartz and decomposed felspar, with a decomposed ferruginous mineral.

Fine washings (71 per cent.), composed of vegetable matter (4.2 per cent.) and clay and mineral particles (66.8 per cent.).

Chemical Composition

Total silica	...	...	...	...	...	...	50.94
Ferric oxide	...	...	..	...	...	...	14.76
Alumina	...	...	...	...	...	...	19.80
Lime	...	...	..	...	...	...	6.58
Magnesia	...	...	...	...	...	...	3.61
Loss on ignition	...	..	...	...	...	...	4.20
							<hr/>
							99.89

In these analyses the lime and magnesia probably belonged to some ferro-magnesian mineral, which was subsequently transformed into what is given here as "decomposed ferruginous mineral," the advanced state of decomposition preventing its determination.

(5) BROWN SAND.

To four samples of sediment dredged in 30 feet near the coast west of Urquhart bay we give the name of Brown Sand. One of the samples has the following composition:—

Minerals (69 per cent.), angular, mean diameter 0.2 mm., mostly made up of quartz, coloured reddish by a coating of iron oxide. Decomposed mica, hornblende, and plagioclase are also represented. The sand contains a few small fragments of rocks, 1 to 3 millimetres in diameter.

Fine washings (31 per cent.), composed of vegetable matter (4·4 per cent.) and fine mineral particles (26·6 per cent.). There is no clayey matter.

Chemical Composition.

Total silica	...	...	...	...	...	...	77·62
Ferric oxide	...	...	...	...	...	...	3·60
Alumina	...	...	...	...	...	...	5·20
Lime	...	...	...	...	...	...	5·88
Magnesia	...	...	...	...	...	...	2·20
Loss on ignition	...	...	...	...	...	...	4·40
							98·90

The alumina, lime, and magnesia are most likely due to the mica and hornblende, whilst the defect of 1·10 per cent. might represent the alkalis.

CONCLUSION.

Loch Ness includes two deep basins separated by a barrier formed by the delta of the Foyers river. The muds from the south-western or Invermoriston basin contain a large amount of vegetable or peaty matter, brought down the lake probably by the rivers Tarff and Oich, with mineral particles coming from the disintegration of the rocks, transported by the streams. Small concretions of peroxide of iron and dioxide of manganese were dredged at one station. The muds often gave the characteristic reaction of manganese. On the slopes the muds are sandy, and of a red-brown colour, due to the presence of oxide of iron.

The muds from the north-eastern or Urquhart basin contain far less vegetable matter than those from the south-western basin, which may be due to the Foyers barrier retaining the vegetable matter in the upper basin. In the north-eastern basin the vegetable matter increases with the depth, which is contrary to what is observed in the south-western basin. Off Urquhart bay the contour-lines approach each other very closely, and the vegetable matter brought down the lake by the river Enrick is carried towards the deeper part of the basin. Great differences are observed in the muds from the slopes on the two sides of the loch. On the north-western slope we find especially a red sandy mud, coming without doubt from the washing out of the shore, composed of Old Red Sandstone. On the south-eastern slope we have a fine yellow clay, with fragments of rocks and large mineral particles without vegetable matter. The deposition of the clay in this position may be due partly to the strong prevailing westerly winds of Loch Ness giving rise to waves and currents, which would carry the fine clayey matter brought down by the Inverfargig river towards the south-eastern shore. Three stones from a depth of 100 feet, opposite Inverfargig pier, were covered with a dark ring of manganese dioxide, marking out the line between the mud and water, as was pointed out by Sir John Murray and Mr. Robert Irvine in their valuable paper: "On Manganese Oxides and Manganese Nodules in Marine Deposits."*

IV.

MIRAGES ON LOCH NESS.

A KIND of mirage is one of the most familiar phenomena on Loch Ness, especially in winter and spring. It is best seen in the morning. Distant objects, such as the steamers plying on the lake, appear as though raised above the surface and floating in the air.

* *Trans. Roy. Soc. Edin.*, vol. 37, p. 721 (1894).

The most constant feature of the Loch Ness mirages is seen at promontories some miles distant. The shore-line at the promontories, though really nearly parallel with the horizon, is caused by the mirage to appear to form an angle with the horizon. When this angle is great (say 60° or more), the promontories appear like overhanging cliffs. When the angle is very acute, they seem to be suspended over the horizon. Objects which are known to be below the horizon are brought into view. The receding steamer, after sailing out of sight, will reappear miles further away, raised high above the loch and looking very large. The promontory at Dores appears as a conspicuous island in the middle of the loch. The fathers in the Benedictine Monastery at Fort Augustus tell that on one occasion a snow-covered mountain appeared over the end of the loch. These phenomena are best marked at a distance of several miles from the observer. The steamer, sailing away from the observer, seemed, at the distance of a mile or more, to leave the surface of the loch and sail up into the air.

Signs of the mirage were sometimes to be distinguished at lesser distances. Standing on the deck of the Lake Survey yacht *Rhoda*, when the eyes would be 7 or 8 feet above the water, there could often be seen on the rocks of the nearest parts of the shore a conspicuous horizontal line, looking just like a high-water mark. In the reports of the Balatonsee Commission, mirages of a similar nature are discussed. Von Cholnoky explains how they arise through the formation of a lower stratum of warmer air, heated from the lake. In shallow lakes like Lake Balaton, the mirage is essentially a summer phenomenon. The lake remains warm during the night when the air cools.

In Loch Ness the converse is the case. The great body of water maintains a moderate temperature throughout the year. In summer the lake rarely attains to 60°F , and so the air may frequently remain as warm as the lake, though mirages may occur after any cold night. In winter the lake maintains a high temperature, rarely falling below 42°F or 43°F , and thus the air will fall to a much lower temperature almost every night, and a well-marked layer of warmer air be formed by morning over the surface of the lake, giving rise to the mirage.

V.

“STORM-WEATHER” AT FORT AUGUSTUS.

Notes communicated by Dom CYRIL VON DIECKHOFF.

THE general features of well-developed “storm-weather” are low barometer, dry haze, wind usually south-east, blowing in isolated gusts (“isolated” with regard to space and time), low strata of cloud forming along lines parallel to the Great Glen, small cumuli forming rapidly in the air and drifting towards the north-west, where they mass and form large strata, often of very dark and threatening appearance. Little or no rain falls during the perfect type, but rain often comes when it breaks up. These small cumuli are well known as indications of gales from the south-east, and are called by the local sailors “Pack-merchants” (*i.e.* pedlars). There are various sub-species of this kind of weather, especially one where the wind is constantly shifting in every direction, the clouds all the while coming from the south-east.

In another type there is a north-east wind (warmer than the ordinary north-east wind), while the clouds come from the south-east. On these occasions the height of the lowest cloud is never much above 3000 feet. There are often several layers at different heights, all in a north-east to south-west direction—even

alto-stratus pieces lie occasionally in this direction; their motion is usually very slow; cirrus comes slowly from the south-west.

"Storm-weather" may occur at any time of the year. The strongest gales, or at least the fiercest gusts, which we get on the loch, come from the south-east. On very rare occasions there has been noticed a kind of reverse to the "storm-sky" during a north-west wind.

VI.

NOTES ON THE GEOLOGY OF THE NORTH-EAST PART OF THE NESS BASIN.

By B. N. PEACH, LL.D., F.R.S., and JOHN HORNE, LL.D., F.R.S.

ONLY a small portion of the Ness area has been mapped by the Geological Survey. It is situated in the north-east part of the basin, and includes the tract at the mouth of Loch Ness and on either side of the river issuing from that loch. It comprises a small part of Loch Ness, Loch Dochfour, Loch Ashie, Loch Abban, and Loch Laide.

The geological structure of the northern part of the Ness basin is well defined. The basin is traversed by the great fault that runs along Loch Ness, which is continued north-eastwards to Tarbat Ness, thus giving rise to the prominent cliff bounding the Moray firth in the Black Isle. This powerful dislocation, which has been a line of weakness in the Earth's crust at successive geological periods and is evidently related to the earthquake movements that periodically affect the Inverness district at the present time, has a marked downthrow to the south-east. The exact position of the line of fault in the Ness valley is concealed by superficial deposits, but its course probably extends from near the western shore of Loch Ness at Lochend, north-east by Loch Dochfour, Dunearn cottage, and Kinmylies, to the Beaully firth east of Kessock ferry.

The effect of this great dislocation in the Ness valley is to let down the Old Red Sandstone strata on the south-east side against the crystalline schists and gneisses of Dochfour hill, the Abriachan granite, and the basal conglomerates and sandstones of Dunearn hill and Craig Leach on the north-west. The schistose rocks of Dochfour hill, which are pierced by the Abriachan granite, consist of quartz-biotite-granulites and felspathic gneisses, traversed by numerous veins of pegmatite. Occasional lenticles of garnetiferous hornblende-schist are associated with the gneisses, and a band of limestone also occurs in the schistose series at Blairnahanachrie, west-north-west of Dochgarroch. From their lithological characters, these crystalline schists have been referred to the Moine Series of the Geological Survey, the members of which are regarded as altered representatives of sedimentary deposits.

The triangular area of Old Red Sandstone on the west side of the valley of the Ness, extending from Dochgarroch north-east to Clachnaharry, and west to the Bunchrew burn, consists of coarse conglomerates and grits that dip to the north-west, and are overlain by sandstones, flags, and shales. Along their western margin they are bounded by a fault, with a downthrow to the east, which is probably a branch of the great dislocation running along Loch Ness.

On both sides of the valley of the Ness there is abundant evidence of intense glaciation of the region. On the elevated plateau west of the Ness valley the direction of the ice-movement varied from 25° to 35° north of east. The ice that issued from the Great Glen flowed more or less parallel to the long axis of Loch Ness, that is, in a north-easterly direction, but the trend became more easterly as it

approached the basin of the Moray firth. There is a wide-spread covering of boulder clay, with scattered groups of moraines, along the ridge extending from Dores north-east by Culloden moor. There is also a remarkable development of fluvioglacial gravels, high river terraces, and remains of raised beaches at the mouth of Loch Ness, on both sides of the valley of the Ness, and on the south shore of the Beaully firth.

Loch Ashie is a shallow lake surrounded by drift, with a fine series of moraines on its eastern side. Loch Laide also occupies a hollow in the drift, with small exposures of crystalline schists in places near its margin. Loch Abban lies in a hollow in the stratified deposits at the mouth of Loch Ness, which may be of fluvial origin.

VII.

NOTES ON THE BIOLOGY OF THE LOCHS OF THE NESS BASIN.

By JAMES MURRAY.

COLLECTIONS of plankton were made in twenty-seven lochs in this basin. With the exception of the lochs in the Great Glen itself, most of these lochs are at a considerable elevation, occupying the high tableland on the east of Loch Ness, or the higher mountainous tract on the west.

The situation of the lochs in two alpine masses, separated by the deep cleft of the Great Glen, gives rise to some peculiarities in distribution, most marked in the species of *Diaptomus* and the more conspicuous planktonic desmids.

A number of species were only collected on one side of the Great Glen. These peculiarities are probably due to the fact that the lochs to the east of Loch Ness were surveyed in spring or early summer, when the water was still cold, while those to the west were surveyed after midsummer, when they were about at the maximum temperature.

Diaptomus gracilis was here, as elsewhere, almost universal, but was not seen in several of the eastern lochs.

D. laticeps was in Loch Ness and the other lochs in the Great Glen. It was not seen in any loch to the west, but was frequent in lochs to the east of Loch Ness. In Loch Ness the blue *Diaptomus* (identified by Mr. Scourfield as *D. laticeps*) is somewhat small and pale in colour. In other districts, and especially in hill lochs, it is of larger size and brighter colours—blue or occasionally red. There is some doubt as to the identity in all cases, and naturalists have given different identifications of the Loch Ness animal.

D. laciniatus, in contrast to *D. laticeps*, was only found to the west of the glen, in lochs high above the sea. To the east, though it was not in any of the lochs surveyed, it was in some lochs at a great elevation on Carnahoulin.

Desmids.—The conspicuous planktonic desmids, which constitute probably the most distinctive feature of the western Scottish plankton, are not very well represented in the lochs of the Ness basin. There are few species, but they include several of the largest and most beautiful. They show no marked preference for the one side of the glen more than the other, but the greatest number of species is in Loch Aslaich, which lies west of Loch Ness.

Micrasterias apiculata, var. *fibriata*, was in Loch Aslaich, and the var. *brachyptera* was found only once in Loch Ness.

M. radiata, Hass (*M. furcata*).—This very local species was in Loch Aslaich.

Staurostrum furcigerum, Bréb.—In Loch Bran, at Foyers.

S. longispinum (Bail.).—In Loch Aslaich and several neighbouring lochs.

S. ophiura, Lund.—Loch Ness and Loch Aslaich.

S. sesangulare (Bulu.).—Loch Garth, near Foyers.

S. brasiliense, Nordst.—Loch Aslaich.

Euastrum verrucosum, Ehr., *Micrasterias papillifera*, Bréb., *Xanthidium antilopeum* (Bréb.), *Staurastrum gracile*, Rolfs, *Staurastrum lunatum*, var. *planctonicum*, West, and one of the beaked *Oosteria*, which I identify as *C. setaceum*, Ehr., are the most generally distributed desmids in the basin.

Crustacea.—Apart from the Calanidæ, a few of the Crustacea appear to be local in the district.

Sida crystallina.—Only seen in Loch Ness and Loch Aslaich.

Diaphanosoma brachyurum.—Only noted in the lochs of the Great Glen and some lochs to the west. The eastern lochs were doubtless surveyed before its season.

Holopedium gibberum.—Noted in scarcely half the lochs, but those on both sides of the Glen and at all elevations.

Leptodora was only seen in the lochs of the Glen and Loch Tarff; *Polyphemus* in the Glen and some lochs to the west; *Bythotrephes* in the Glen and Lochs Tarff and Ruthven to the east.

Rotifera.—*Conochilus unicornis* was generally distributed; *C. volvox* only in Lochs Ness, Laide, and Knockie.

Floscularia pelagica.—Lochs Ness, Oich, and Uanagan.

Synchaeta pectinata.—Lochs Oich and Uanagan.

Anopus testudo.—Lochs Ness and Uanagan.

Triarthra longiseta.—In five lochs on the east side of the basin; apparently a cold-water species.

Gastropus stylifer.—Loch Ness and five lochs to the east, and Loch Aslaich to the west.

Sarcodina.—*Clathrulina* was not seen except in the lochs of the Great Glen. *Nebela bicornis*, West, though found in Loch Ness, was not got in the plankton, but while dredging in the shallow water of Inchnacardoch bay.

Loch Ness.—Loch Ness was made the subject of a more thorough, though still far from exhaustive, biological investigation than any other Scottish loch. A very large proportion of all the lacustrine organisms known in Scotland have been found in this loch.

The great majority of the species in all the larger groups—Crustacea, Rotifera, Sarcodina—have been got in Loch Ness, the only large group not very fully represented being the desmids. Some of the small groups have hardly been studied, except in Loch Ness, and it is the only loch the abyssal fauna of which is fairly well known.

To give any detailed account of the hundreds of species found in the loch would traverse too much the same ground as the general report on the "Biology of the Scottish Lochs," now in preparation. There will therefore be given here simply an epitome of the biology, and a comparison with the other lochs in the Ness basin.

The Plankton.—The plankton is the average plankton of Scottish lakes, with a very small admixture of the more local species. It is very poor in species, and always very small in quantity. No approach to "flowering" of the water has been noted. The greatest quantity was collected in late autumn, 1903, during the night, when a considerable migration from the deeper water to the surface

evidently took place, as the quantity collected during the preceding day was much less. The plankton varies little throughout the year, a fact probably correlated with the low annual range of temperature, which is less than 20°·0 Fahr., while the upper limit of about 60°·0 is rarely touched.

About half the species of Crustacea remain all the year round, those which are absent in winter being *Bythotrephes*, *Polyphemus*, *Leptodora*, and *Diaphanosoma*. *Holopedium* was noted by Mr. Scourfield, but was never found during the systematic investigation afterwards. *Diaptomus laticeps*, Sars., appears to persist all the year round, and was found carrying eggs in March, when the temperature is at its lowest. *Clathrulina* was generally present, and *Volvox* occasionally.

There is a great contrast between Loch Ness and Loch Lochy in the relative abundance of the phytoplankton. Loch Lochy is very rich, and Loch Ness very poor. The two lochs are only some 10 miles apart, and are apparently under almost identical conditions. Loch Lochy, being in an almost uninhabited district, should be purer than Loch Ness, but a slight pollution is generally favourable to vegetable growth.

Littoral region.—Though there are only a few sheltered bays in Loch Ness, where littoral vegetation can establish itself, the microfauna and microflora found among the larger vegetation are very considerable, and constitute, indeed, the chief part of the species in the loch.

A great many of the animals extend downwards to a very considerable depth, and about forty species (exclusive of Rhizopods), including many Crustacea, Rotifera, Tardigrada, Worms, and the larvæ of many insects, have been collected as far down as 800 feet. Shells of all the Rhizopods extend to the greater depth, and many live at greater depths than 300 feet.

In Inchnacardoch bay Mr. Scourfield found *Ophryocoxus gracilis* for the first time in Britain; and the rare *Ilyocypris agilis*, previously known in several places in England, was got in the same locality.

Abyssal region.—In Loch Ness a large proportion of the littoral species extend to about 300 feet in depth, probably because of the very steeply sloping sides. Those species only are considered as truly abyssal which are generally distributed over the mud, into the deepest part of the loch. A small association of animals is found thus distributed, and the abyssal region, being defined as the bottom where this association is found almost free of admixture, must be considered to begin at about 300 feet. Exclusive of Rhizopods, there are about a dozen animals constantly found in this region, comprising—1 Mollusc, *Pisidium pusillum*, Gmel.; 3 Crustacea, *Cyclops viridis*, Jurine, *Candona candida*, Müll., and *Cypria ophthalmica*, Jurine; 3 worms, *Stylodrilus galatæ*, Vejd., *Monotus morgiensis*, Du Plessis, and an undetermined Oligochaete; 1 insect, *Chironomus* (larva); several Infusoria, parasites on the Molluscs and Crustacea.

Several other species occur casually at great depths, such as *Hydra*, *Limnæa*, *Lyneceus affinis*, and *Proales daphnicola*.

A small char, *Salmo alpinus*, was dredged at a depth of over 500 feet.

Larvæ of *Tanytus* and some other diptera are frequent, but less constant than *Chironomus*.

Rhizopods.—Dr. Penard has identified about forty species and varieties from depths of more than 300 feet. They thus constitute the greater part of the species in our abyssal region, but their presence there is of little special interest, and there are only some half a dozen species and varieties which are doubtfully supposed to be peculiar to deep lakes.

Summary of the Number of Species.

	Species.		Species
Mollusca	5	Dinoflagellata	8
Hydrachnida	1	Phanerogamia	83
Tardigrada	22	Equisetaceæ	1
Insecta	6	Lycopodiaceæ	1
Crustacea	55	Characeæ	2
Rotifera	151	Mosses	6
Gastrotricha	2	Hepatics	2
Worms	12	Florideæ	2
Coelenterata	2	Chlorophyceæ	46
Infusoria	11	Myxophyceæ (Report in prepara-	
Sarcodina	67	tion)	—
Mastigophora	3	Bacillariaceæ	20

We have thus a total of 453 species recorded for Loch Ness, excluding all Vertebrata, blue-green Algae, and some other groups on which no work has been done. The Hydrachnida, Insecta, Worms, Infusoria, Chlorophyceæ, and Diatoms, have all been insufficiently studied, and the lists could be easily increased.

VIII.

NOTES ON THE AQUATIC FLORA OF THE NESS AREA.

By GEORGE WEST.

FROM certain points of view, plants may increase in interest and value in ratio to their rarity; of equal worth philosophically are those plants that occur in great abundance. The former, being scattered as individuals, or as small associations over restricted areas, are possibly, at present, of but small import in the economy of nature. The commoner plants, however, by reason of their dominance and abundance, become important agents, not only as a plant-covering to the Earth, but also in the effect they produce in the physiography of a country: barren tracts become heath or forest by the extension of vegetation; lakes are converted into morasses, moors, or even into land suitable for agriculture by the accumulation of plant-remains. Such natural operations tend to increase the wealth and social prosperity of man. As examples on the other hand, the sudden increase of a baneful fungus may bring ruin to thousands of agriculturists, and carry famine to the million; or morasses in hilly districts may slide into cultivated valleys, and completely overwhelm sites of human activity and wealth. These and many other phenomena are brought about by the predominance of certain classes of plants. How great, therefore, are the interests awakened upon the fields of practical thought and knowledge by the abundant and dominant plants in their never-ceasing antagonism with one another and with other forces of nature!

It is chiefly with some of the factors that control the dominant water-plants of higher organization in the Ness area that the following remarks are concerned.

The two great factors that contribute towards the distribution of the plant-covering over the surface of the Earth, and through its waters, are food and climate. Notwithstanding the conditions for plant-life being so often remote from the ideal, yet the plastic power that plants possess of adapting themselves to the various combinations of edaphic and climatic conditions is so great that there are comparatively few spots in which some plant or other is not able to thrive and carry on its metabolic activities. With aquatic plants the influence of the substances, food or otherwise, held in solution in the water, is vastly greater than that of climate.

The edaphic conditions dominating the flora in the majority of the numerous lakes of the Ness area are indirectly influences of climate. Indeed, the rock-basins that contain the lakes are themselves chiefly the result of climatic effects, because they were scooped out during a former period of glaciation. The study of our lake flora brings us, therefore, to consider the cause of a glacial epoch, and is thus the usher to one of the most abstruse and sublime realms of thought that the human intellect has ever been able to grapple with, so complicated and interwoven are the modes of nature's working. But to our more mundane considerations.

The yellow-brown colour of the waters of our highland districts is a matter of common observation, and is due to the water-supply from the mountains percolating enormous quantities of peat before reaching the lakes. This, then, would appear to be an edaphic influence; and so it is, but the existing conditions—the presence of peat on the mountains—have been brought about by direct climatic influence. The climatic conditions that obtain in the exposed portions of the highlands are more favourable to the natural production of moorland than of forest. The two formations—moor and forest—are antagonistic to one another, the tendency being for the moorland to extend from the higher situations over the domain of the natural forest of the lower altitudes. The principal natural causes for this victory of moor over forest are—(1) wind, which is much less antagonistic to moor plants than to trees; (2) the peculiar acid humus that is formed abundantly from the remains of certain dominant moor plants, and which acts inimically towards trees.* These natural conditions have undoubtedly been unwittingly hastened during the past two thousand years by the destructive influence of man on forest.

It is the presence of the peat extract in the water that is the dominating factor governing the aquatic flora of the Ness area. Its presence excludes directly a number of aquatic or semi-aquatic plants that might otherwise thrive. It obliterates any calcium carbonate that might be present, and thus renders the water untenable to calciphilous plants. On the other hand, certain calcifugal plants, having become accustomed to tolerate the presence of humic acids, abound. I scarcely know that one should say the latter thrive the better through lack of competition with the former, because commonly it is not that competition for available space is so great, as that the local conditions favour the dominant production of an individual species.

The peat extract darkens the water, and this restricts the depth zone to which submersed aquatics will grow, because they are unable to carry on photosynthesis beyond a very limited depth, owing to want of light. Therefore the photic zone throughout which there exists sufficient light for the proper development of the higher plants does not extend to a greater depth than about 30 feet in the lochs of the Ness area, and is often very much less than that. The extreme depth to which such plants as *Nitella opaca* and *Fontinalis antipyretica* will flourish in these lakes may roughly be estimated by multiplying by four the greatest depth at which one can see the brown gravel at the bottom, when looking over the shaded side of a boat about midday in the summer, when the sun is shining brilliantly, with the water perfectly calm, and the boat still. Such a depth in Loch Ness is from 7 to 8 feet.

This multiplier, however, does not hold where the multiplicand is considerably greater. Thus at Loch Fiant, on Lismore, one may see the bottom at a depth of 25 feet under the above conditions, but plants do not thrive at a greater depth than 40 to 45 feet. Possibly this is because the less refrangible rays of the spectrum,

* Space does not permit an explanation here of the involved complications brought about by these factors.

which are most necessary to photosynthesis, become insufficient at greater depths; although the rays of shorter wave-length may penetrate to greater depths in sufficient quantity to fulfil the requirements of the metabolic activities that are dependent upon them. It must be borne in mind that the yellow-brown colour of the peaty lakes probably neutralizes the photo-chemical action of the violet rays at no great depth. We know that Rhodophyceæ thrive in the sea at least to a depth of 250 feet, but in all probability their reddish colour accentuates the photo-chemical action of the very feeble yellow-green rays* that penetrate such a depth of water. In similar manner a photographic plate becomes more sensitive to certain rays when its film is stained with suitable colours. Thus a film stained with erythrosin becomes sensitive to green and yellow. Exact information on these points in various waters of Scotland is much needed.

By reason of the preserving action of humic acids, the organic remains about the shores of the lakes do not readily decay, but undergo a slow process of disintegration, and form a sort of liquid peat. Owing to this action, suitably situated shallow places about peaty lakes become reclaimed by the growth of land-winning plants quicker than in water that is free from humic acids.

The last glacial epoch, after destroying the vegetation of Scotland, immediately began the formation of more numerous lake-basins for the reception of a greater aquatic flora after its disappearance. Not only this, for we find other results of glaciation actually dominating the vegetation in certain of our lochs at the present moment. At Lochs Oich and Lochy, for example, the sides of the adjacent mountains are coated with glacial drift-gravel. This gravel is brought into the lakes by the numerous streams in great abundance, and deposited upon the shores. Under the erosive power of the waves, the constant movement of this gravel upon the littoral entirely prevents the growth of aquatic phanerogams over a considerable area of the margin of the lakes. Again, in many places a steep escarpment, due to glacial action, enters a lake immediately, so that water too deep for phanerogams occurs without any shore whatever; instance Loch Ness opposite Invermoriston, where a depth of 652 feet may be sounded at about 120 yards from the margin. Here we see the indirect effect of a past epoch upon the flora of existing lakes, the lakes themselves being the direct result of that period.

Climate also affects the local distribution of the plants in each loch more or less. The prevailing, and frequently strong, winds are westerly; consequently there is, upon the eastern shore of a lake, a very considerable and oft-recurring wave-action. Acting upon a rocky or stony shore, this erosive power entirely prevents the growth of the higher plants in the shallow water where its influence is felt (see Fig. 5, p. 48). Unless sheltered by adjacent hills, all the lakes will be almost, or quite, devoid of vegetation on their eastern shore, whilst the western shore, and bays sheltered from the prevailing wind, will have an abundant vegetation. The algæ of the seashore may be cited as an example, on the other hand, that plants can develop, and luxuriantly too, on a rocky shore subjected to powerful erosion, but the case is here entirely different. The seeds of phanerogams, excepting the tropical Podostemaceæ, have no power to firmly attach themselves to rocks and stones, as have the spores of seaweeds. Still we do find, even in exposed parts of our lakes, fixed rocks often covered with mosses, hepatics, algæ, etc.

Wind is an important factor in dwarfing the semi-aquatic vegetation about the

* The rays for maximum photosynthesis in the red seaweeds are the yellow-green; these penetrate water sufficiently for photosynthesis to about five times the depth that red rays do.

littoral region of the lakes; especially is this the case with those situated in the more elevated and exposed positions.

The sudden rise of water to any great or prolonged extent is inimical to the well-being of plants in the lochs, particularly so if the water is extremely peaty. This is very pronounced at Loch Mhor, where an ever-changing level—due to the rainfall on the one hand, and the water used by the British Aluminium Company at Foyers on the other hand—does not allow a flora to grow at all. Previously existing trees at the margin have been drowned by the raising of the water-level (see Fig. 2, p. 44).

In these peaty lakes the aquatic plants are usually remarkably free of epiphytic organisms, and also of mud; neither do they bear that deposit of calcium carbonate so common to aquatic plants in lakes that are devoid of the peat extract. Humic acids, and perhaps carbonic acid too, in the waters almost extinguish molluscan life. Consequently one does not find the aquatic vegetation destroyed by these creatures, as is commonly the case where certain of them, especially *Limnaea*, abound.

The great variation between the summer and winter temperature of the water of the higher mountain lochs doubtless affects the flora to a greater extent than in those of lower altitude. These hill lochs are often shallow, and the comparatively small body of water may become heated to 70° Fahr. in summer, and may be frequently covered with ice in winter and spring. The ice often remains upon such lochs until April. Before its final disappearance, large shoals of broken ice grind upon the shores with surprising power and noise, and would destroy any littoral vegetation within its influence. Considering that such floating ice shifts about the loch with every change of wind, it is scant wonder that one so often finds these hill lochs devoid of marginal vegetation. In the great body of water of the large and deep lochs of lower altitude the temperature is more equable, winter and summer records not varying more than 10° to 20° Fahr., and such lochs seldom freeze.

It has already been pointed out that these peaty waters contain little or no calcium bicarbonate. Consequently there is no incrustation of calcium carbonate upon the aquatic plants. A necessary corollary to such antecedents is that no lime deposit resulting from the metabolism of plants is being laid down in these peaty lochs, as is the case where the water is charged with calcium bicarbonate.

The mud occurring in the peaty lakes of the Ness area is seldom of the black evil-smelling kind, such as is commonly found in non-peaty lakes, e.g. Duddingston Loch, near Edinburgh. In the latter case the decomposition of organic matter takes place with far greater rapidity than in water charged with humic acids. After the first stages of rapid decomposition comes the formation, among other substances, of ammonia, carbon dioxide, and hydrogen sulphide. It is the last mentioned that gives the mud such an offensive odour when disturbed. In the presence of humic acids this rapid putrefaction does not occur. Instead, the disintegration takes place slowly by a kind of carbonizing process. At the bottom of Loch Ness vegetable remains first become brown, then black and brittle, gradually crumbling to powder, and apparently no obnoxious gas is generated. Putrefaction does not take place, but rather a kind of desiccation—if one may apply this term to a sub-aqueous process. Likewise the mud from the bottom of Loch Ness has not the slightest offensive odour, neither does it stain one's hands as the fétid kind does.

Many plants, e.g. *Phragmites communis*, *Sparganium ramosum*, *Alisma Plantago*, etc., always grow more luxuriantly when the mud is black and fetid; but other species, e.g. *Sphagnum*, various sp., *Isoetes lacustris*, *Lobelia Dortmanna*, etc., are unable to endure that kind of mud, not directly because of its presence, but because other factors, e.g. difference in food-salts, are correlated with the presence of this or that kind of mud. A number of other plants are comparatively indifferent, e.g. *Castalia speciosa*, *Menyanthes trifoliata*, etc.

Again, the aquatic vegetation being restricted to the photic zone, the greater portion of the bottom of these deep lakes receives but a small supply of organic remains. The refuse-eating fauna existing at the bottom is consequently able to maintain an equilibrium between supply and demand, so that the lake-bottom consists largely of the non-fetid excrement of these creatures. In shallow non-peaty lakes, whose floor is wholly carpeted with vegetation, e.g. Duddington Loch, the supply of organic detritus is greatly in excess of any refuse-eating fauna that may exist, therefore fetid mud results from the process of unhindered decomposition.

From the foregoing statements, it will be readily understood that the flora of the lakes in the Ness area is subjected to many varying conditions, and in order to maintain a proper tone of health a plant has of necessity to respond in suitable ways to all the varying external impressions. A plant is therefore in a constant and continual state of change, owing to the never-ceasing mechanical, physical, and chemical changes of its unstable environment. The plastic nature of many plants enables them to modify their organs in reciprocation to any fairly constant set of environmental conditions; and it is in this endeavour to accommodate themselves for the maintenance of healthy existence in inhospitable places, that certain deviations from the normal forms of more kindly environments are to be accounted for. That such forms should receive definite specific or varietal names is open to grave doubt. Physiologists and experimental botanists are becoming more and more sympathetic towards the simplicity of the astute George Bentham; and whilst recognizing, as did Bentham, the numerous forms fixed and transient, such are regarded as unit forms of the phylogenesis, or of the retrogression of a species.

In many districts one may distinguish mountain lochs by the presence of certain plants, as, for example, *Isoetes lacustris*, *Lobelia Dortmanna*, *Potamogeton polygonifolius*, *Sparganium natans*, *S. minimum*, etc., and by the absence of reeds at the margin. But in the Ness area the presence or absence of such plants and associations is certainly no criterion of the elevation of a loch. All the plants enumerated are to be found at so low a level as Loch Ness (52 feet above the sea); and a reedy margin is found at quite highland situations, whilst it is almost absent in such low-lying lochs as Oich and Ness. The reason is not one altogether of elevation for the presence or absence of certain plants, but is rather due to the supply of food-salts, and the amount of exposure of the water to winds, coupled with the nature of the shore. The mountain lakes usually drain a very small area, poor in food-salts and rich in acid humus; consequently, only those plants are found in them that can obtain their requirements from an apparently scanty food-supply, combined with the presence of humic acids. Such plants are those that have been associated with mountain lakes. Lowland lakes usually drain a wider area, and soils poor in peat and rich in food-salts, which, although indispensable to most plants, are poison to others. In the area of Lochs Ness and Oich there is but a small amount of soil rich in food-salts available for drainage, compared with the soil poor in food-salts and rich in acid humus. Consequently, the effect of drainage from a small, rich food-area is almost extinguished by the humic acids, and in such lowland lochs we find vegetation identical with that of the highest mountain lakes.

Again, in Lochs Oich and Ness (and, of course, others) we have practically no reedy margin, neither have we in many mountain lakes. The reason for this is the nature of the shore, combined with the erosive power of the waves, leaving altogether out of the question food-supply. On the other hand, in mountain lakes with a sheltered peaty or muddy shore, as in lowland lakes of like nature, we find a reedy or sedgy margin. Highland lochs are usually in situations fully exposed to the fierce winds, their shores rocky or stony; consequently, they have few plants

about their margins. Their water, being poor in food-salts and rich in humic acids, has a restricted aquatic flora; but the same conditions may obtain in the lowlands, when the flora of the lakes will be similar. On the other hand, a highland loch having a supply of food-salts, with a suitable shore and sheltered from prevailing winds, may quite well have the character of a lowland loch regarding its flora.*

COAST PEOPLES.

By ELLEN CHURCHILL SEMPLE.

PART I.

OF all geographical boundaries, the most important is that between land and sea. The coast, in its physical nature, is a zone of transition between these two dominant forms of the Earth's surface; it bears the mark of their contending forces, varying in its width with every stronger onslaught of the unresting sea, and with every degree of passive resistance made by granite or sandy shore. So too in an anthropogeographical sense, it is a zone of transition. Now the life-supporting forces of the land are weak in it, and it becomes merely the rim of the sea; for its inhabitants the sea means food, clothes, shelter, fuel, commerce, highway, and opportunity. Now the coast is dominated by the exuberant forces of a productive soil, so that the ocean beyond is only a turbulent waste and a long-drawn barrier: the coast is the hem of the land. Neither influence can wholly exclude the other in this amphibian belt, for the coast remains the intermediary between the habitable expanse of the land and the international highway of the sea. The break of the waves and the dash of the spray draw the line beyond which human dwellings cannot spread; for these the shore is the outermost limit, as for ages also in the long infancy of the races, before the invention of boat and sail, it drew the absolute boundary to human expansion. In historical order, its first effect has been that of a barrier, and for the majority of peoples this it has remained; but with the development of navigation and the spread of human activities from the land over sea to other countries, it became the gateway both of land and sea—at once the outlet for exploration, colonization, and trade, and the open door through which a continent or island receives contributions of men or races or ideas from transoceanic shores. Barrier and threshold: these are the rôles which coasts have always played in history. To-day we see them side by side. But in spite of the immense proportions assumed by transmarine intercourse, the fact remains that the greater part of the coasts of the Earth are for their inhabitants only a barrier

* For further information on the lochs and their plants, see "A Comparative Study of the Dominant Phanerogamic and Higher Cryptogamic Flora of Aquatic Habit, in Three Lake Areas of Scotland" (with 110 illustrations), by George West, *Proc. Roy. Soc. Edin.*, vol. 25, pp. 967-1023 (1905).

and not an outlet, or at best only a base for timorous ventures seaward that rarely lose sight of the shore.

As intermediary belt between land and sea, the coast becomes a peculiar habitat which leaves its mark upon its people. We speak of coast strips, coastal plains, "tidewater country," coast cities; of coast tribes, coast peoples, maritime colonies; and each word brings up a picture of a land or race or settlement permeated by the influences of the sea. The old term of "coast-line" has no application to such an intermediary belt, for it is a zone of measurable width, and this width varies with the relief of the land, the articulation of the coast according as it is uniform or complex, with the successive stages of civilization and the development of navigation among the people who inhabit it.

Along highly articulated coasts, showing the interpenetration of sea and land in a broad band of capes and islands separated by tidal channels and inlets, or on shores deeply incised by river estuaries, or on low shelving beaches which screen brackish lagoons and salt marshes behind sand reefs and dune ramparts, and which thus form an indeterminate boundary of alternate land and water, the zone character of the coast in a physical sense becomes conspicuous. In an anthropological sense the zone character is clearly indicated by the different uses of its inner and outer edge made by man in different localities and in different periods of history.

The old German maritime cities of the North sea and the Baltic were located on rivers from 6 to 60 miles from the open sea, always on the inner edge of the coastal belt. Though primarily trading towns, linked together once in the sovereign confederacy of the Hanseatic League, they fixed their sites on the last spurs of firm ground running out into the soft, yielding alluvium, which was constantly exposed to inundation. Land high enough to be above the ever threatening flood of river and storm-driven tide on this flat coast, and solid enough to be built upon, could not be found immediately on the sea. The slight elevations of sandy "geest" or plateau spurs were limited in area and in time outgrown. Hence the older parts of all these river towns, from Bremen to Königsberg, rest upon hills, while in every case the newer and lower part is built on piles or artificially raised ground on the alluvium.* So Utrecht, the *Ultrajectum* of the Romans, selected for its site a long raised spur running out from the solid ground of north-western Germany into the water-soaked alluvium of the Netherlands. It was the most important town of all this region before the arts of civilization began the conquest by dyke and ditch of the amphibian coastal belt which now comprises one-fourth of the area and one-half

* Rudolph Reinhard, 'Die Wichtigsten Deutschen Seehandelstädte,' pp. 24, 25. Stuttgart: 1901. For Hamburg, see Joseph Partsch, 'Central Europe,' p. 291. London 1903.

the population of the Netherlands.* So ancient London marked the solid ground at the inner edge of the tidal flats and desolate marshes which lined the Thames estuary, as the Roman Camulodoum and its successor Colchester on its steep rise or *dun* overlooked the marshes of the Stour inlet.† Farther north about the Wash, which in Roman days extended far inland over a wide area of fens and tidal channels, Cambridge on the river Cam, Huntingdon and Stamford on the Nen, and Lincoln on the Witham—all river seaports—defined the firm inner edge of this wide low coast. In the same way the landward rim of the tidal waters and salt marshes of the Humber inlet was described by a semicircle of British and Roman towns—Doncaster, Castleford, Todcaster, and York.‡ On the flat or rolling West African coastland, which lines the long shores of the Gulf of Guinea with a band 30 to 100 miles wide, the sandy, swampy tracts immediately on the sea are often left uninhabited; native population is distributed most frequently at the limit of deep water, and here at head of ship-navigation the trading towns are found.§

While, on low coasts at any rate, the inner edge tends to mark the limit of settlements advancing from the interior, as the head of sea navigation on river and inlet it has also been the goal of immigrant settlers from oversea lands. The history of modern maritime colonization, especially in America, shows that the aim of regular colonists, as opposed to mere traders, has been to penetrate as far as possible into the land while retaining communication with the sea, and thereby with the mother country. The small boats in use till the introduction of steam navigation fixed this line far inland and gave the coastal zone a greater breadth than it has at present, and a more regular contour. In colonial America this inner edge coincided with the "fall-line" of the Atlantic rivers, which was indicated by a series of seaport towns, or by the inland limit of the tides, which on the St. Lawrence fell above Quebec, and on the Hudson just below Albany.

With the recent increase in the size of the vessels, two contrary effects are noticed. In the vast majority of cases, the inner edge, as marked by ports, moves seaward into deeper water, and the zone narrows. The days when almost every tobacco plantation in tidewater Virginia had its own wharf are long since past, and the leaf is now exported by way of Norfolk and Baltimore. Seville has lost practically all its sea trade to Cadiz, Rouen to Havre, and Dordrecht to Rotterdam. In other cases the zone preserves its original width by the creation of secondary ports on or near the outer edge, reserved only for the largest vessels, while the inner harbour, by dredging its channel, improves its

* *Ibid.*, p. 301.

† John Richard Green, 'The Making of England,' vol. 1, pp. 51-54; maps, pp. 36 and 54. London: 1904.

‡ *Ibid.*, vol. 1, pp. 12 and 63; maps, pp. xxii. and 54.

§ Friedrich Ratzel, 'History of Mankind,' vol. 3, pp. 97, 139. London: 1898.

communication with the sea. Thus arises the phenomenon of twin ports like Bremen and Bremerhaven, Dantzic and Neufahrwasser, Stettin and Swinemünde, Bordeaux and Pauillac, London and Tilbury. Or the original harbour seeks to preserve its advantage by canalizing the shallow approach by river, lagoon, or bay, as St. Petersburg by the Pantiloff canal through the shallow reaches of Kronstadt bay; or Königsberg by its ship canal, carried for 25 miles across the Frisches Haff to the Baltic;* or Nantes by the Loire ship canal, which in 1892 was built to regain for the old town the West Indian trade recently intercepted by the rising outer port of St. Nazaire, at the mouth of the Loire estuary.† In northern latitudes, however, the outer ports on semi-enclosed sea basins like the Baltic become important in the winter, when the inner ports are ice-bound. Otherwise the outer port sinks with every improvement in the channel between the inner port and the sea. Hamburg has so constantly deepened the Elbe passage that its outport of Cuxhaven has had little chance to rise, and serves only as an emergency harbour; while on the Weser, maritime leadership has oscillated between Bremen and Bremerhaven.‡ So the whole German coast and the Russian Baltic have seen a more or less irregular shifting backwards and forwards of maritime importance between the inner and the outer edges.

The width of the coast zone is not only prevented from contracting by dredging and canaling, but it is even increased. By deepening the channel, the chief port of the St. Lawrence river has been removed from Quebec 180 miles upstream to Montreal, and that of the Clyde from Port Glasgow 16 miles to Glasgow itself, so that now the largest ocean steamers come to dock where fifty years ago children waded across the stream at ebb tide. Such artificial modifications, however, are rare, for they are made only where peculiarly rich resources or superior lines of communication with the hinterland justify the expenditures; but they find their logical conclusion in still farther extensions of sea navigation into the interior by means of ship canals, where previously no water highway existed. Instances are found in the Manchester ship canal and the Welland, which, by means of the St. Lawrence and the Great Lakes, makes Chicago accessible to ocean vessels. Though man distinguishes between sea and inland navigation in his definitions, in his practice he is bound by no formula and recognizes no fundamental difference where rivers, lakes, and canals are deep enough to admit his sea-going craft.

Such deep landward protrusions of the head of marine navigation at certain favoured points, as opposed to its recent coastward trend in

* Joseph Partsch, 'Central Europe,' pp. 284-288. London: 1903.

† H. R. Mill, 'International Geography,' p. 251. New York: 1902.

‡ Rudolph Reinhard, 'Die Wichtigsten Deutschen Seehandelsstädte,' pp. 21-22. Stuttgart: 1901.

most inlets and rivers, greatly increase the irregularity of the inner edge of the coast zone by the marked discrepancy between its maximum and minimum width. They are limited, however, to a few highly civilized countries, and to a few points in those countries. But their presence testifies to the fact that the evolution of the coast zone with the development of civilization shows the persistent importance of this inner edge.

The outer edge finds its greatest significance, which is for the most part ephemeral, in the earlier stages of navigation, maritime colonization, and in some cases of original settlement. But this importance persists only on steep coasts furnishing little or no level ground for cultivation and barred from interior hunting or grazing land; on many coral and volcanic islands of the Pacific ocean whose outer rim has the most fertile soil and furnishes the most abundant growth of coco palms, and whose limited area only half suffices to support the population; and in polar and sub-polar districts, where harsh climatic conditions set a low limit to economic development. In all these regions the sea must provide most of the food of the inhabitants, who can therefore never lose contact with its waters. In mountainous Tierra del Fuego, whose impenetrably forested slopes rise directly from the sea, with only here and there a scanty stretch of stony beach between them, the natives of the southern and western coasts keep close to the shore. The straits and channels yield them all their food, and are the highways for all their restless, hungry wanderings.* The steep slopes and dense forests preclude travel by land, and force the wretched inhabitants to live as much in their canoes as in their huts. The Tlingit and Haida Indians of the mountainous coast of southern Alaska locate their villages on some smooth sheltered beach, with their houses in a single row facing the water, and the ever-ready canoe drawn up on shore in front. They select their sites with a view to food supply, and to protection in case of attack. On the treeless shores of Kadiak island and of the long narrow Alaska peninsula near by, the Eskimo choose their village location for an accumulation of driftwood, for proximity to their food supply, and a landing-place for their kayaks and bidarkas. Hence they prefer a point of land or gravel spit extending out into the sea, or a sand reef separating a salt-water lagoon from the open sea. The Aleutian islanders regard only accessibility to the shell-fish on the beach and their pelagic hunting and fishing; and this consideration has influenced the Eskimo tribes of the wide Kuskokwin estuary to such an extent, that they place their huts only a few feet above ordinary high tide, where they are constantly exposed to overflow from the sea.† Only

* Fitz-Roy and Darwin, 'Voyage of the Beagle,' vol. 2, pp. 140, 178; vol. 3, pp. 231-236. London: 1839.

† Eleventh Census, 'Population and Resources of Alaska,' pp. 166-171. Washington: 1893.

among the great tidal channels of the Yukon delta are they distributed over the whole wide coastal zone, even to its inner edge.

The coast Chukches of north-eastern Siberia locate their tent villages on the sand ramparts between the Arctic ocean and the freshwater lagoons which line this low tundra shore. Here they are conveniently situated for fishing and hunting marine animals, while protected against the summer inundations of the Arctic rivers.* The whole western side of Greenland, from far northern Upernivik south to Cape Farewell, shows both Eskimo and Danish settlements almost without exception on projecting points of peninsulas or islands, where the stronger effect of the warm ocean current, as well as proximity to the food supply, serve to fix their habitations; although the remains of the old Norse settlements in general are found in sheltered valleys with summer vegetation, striking off from the fiords some 20 miles back from the outer coast.† Cæsar found that the ancient Veneti, an immigrant people of the southern coast of Brittany, built their towns on the points of capes and promontories, sites which gave them ready contact with the sea and protection from attack from the land side, because every rise of the tide submerged the intervening lowlands.‡ Here a sterile plateau hinterland drove them for part of their subsistence to the water, and the continuous intertribal warfare of small primitive states to the sea-girt asylums of the capes.

In the early history of navigation and exploration, striking features of this outer coast edge, like headlands and capes, became important sea marks. The promontory of Mount Athos, rising 6400 feet above the sea between the Hellespont and the Thessalian coast, and casting its shadow as far as the market-place of Lemnos, was a guiding point for mariners in the whole northern Ægean.§ For the ancient Greeks Cape Malea was long the boundary stone to the unknown wastes of the western Mediterranean, just as later the Pillars of Hercules marked the portals to the *mare tenebrosus* of the stormy Atlantic. So the Sacred Promontory (Cape St. Vincent) of the Iberian peninsula defined for Greeks and Romans the south-western limit of the habitable world.|| Centuries later the Portuguese marked their advance down the west coast of Africa, first by Cape Non, which so long said "No!" to the struggling mariner, then by Cape Bojador, and finally by Cape Verde.

In coastwise navigation, minor headlands and inshore islands were points to steer by; and in that early maritime colonization, which had

* Nordenskiöld, 'The Voyage of the Vega,' pp. 327, 334, 335, 365, 366, 412, 416, 459, 467. New York: 1882.

† G. Frederick Wright, 'Greenland Icefields,' pp. 68-70, 100, 105. New York: 1896.

‡ 'Bello Gallico,' book iii. ch. 12.

§ Ernst Curtius, 'History of Greece,' vol. 1, p. 15. New York.

|| Strabo's 'Geography,' book ii. ch. v. 4; book iii. ch. i. 4.

chiefly a commercial aim, they formed the favourite spots for trading stations. The Phœnicians in their home country fixed their settlements by preference on small capes, like Sidon and Berytus, or on inshore islets, like Tyre and Aradus,* and in their colonies and trading stations they chose similar sites, whether on the coast of Sicily,† Spain, or Morocco.‡ Carthage was located on a small hill-crowned cape projecting out into the Bay of Carthage, and the two promontories embracing this inlet were edged with settlements, especially the northern arm, which held Utica and Hippo,§ the latter on the site of the modern French naval station of Bizerta.

In this early Hellenic world, when Greek sea-power was in its infancy, owing to the fear of piracy, cities were placed a few miles back from the coast; but with the partial cessation of this evil, sites on shore and peninsula were preferred as being more accessible to commerce,|| and such of the older towns as were in comparatively easy reach of the seaboard established there each its own port. Thus we find the ancient urban pairs of Argos and Nauplia, Troezen and Pogon, Mycæne and Eionæ, Corinth commanding its Ægean port of Cenchrææ 8 miles away on the Saronic gulf, to catch the Asiatic trade, and connected by a walled thoroughfare $1\frac{1}{2}$ mile long with Lechæum, a second harbour on the Corinthian gulf which served the Italian commerce.¶ In the same group belonged Athens and its Piræus, Megara and Pegæ, Pergamus and Elææ in western Asia Minor.** These ancient twin cities may be taken to mark the two borders of the coast zone. Like the modern ones which we have considered above, their historical development has shown an advance from the inner towards the outer edge, though owing to different causes. However, the retired location of the Baltic and North sea towns of Germany served as a partial protection against the pirates who, in the Middle Ages, scoured these coasts. Lubeck, originally located nearer the sea than at present, and frequently demolished by them, was finally rebuilt farther inland up the Trave river.†† Later the port of Travemünde grew up at the mouth of the little estuary.

The early history of maritime colonization shows in general two geographic phases: first, the appropriation of the islet and headland outskirts of the seaboard, and later—it may be much later—an advance towards the inner edge of the coast, or yet farther into the interior. Progress from the earlier to the maturer phase depends upon the social

* Grote, 'History of Greece,' vol. 3, 266-267. New York: 1857.

† Thucydides, book vi. 2.

‡ Grote, 'History of Greece,' vol. 3, p. 273. New York: 1857.

§ Strabo's 'Geography,' book xvii. ch. iii. 13, 14.

|| Thucydides, book i. 5, 7, 8.

¶ Strabo, book viii. ch. vi. 2, 4, 13, 14, 22.

** Grote, 'History of Greece,' vol. 3, pp. 4, 191. New York: 1857.

†† Rudolph Reinhard, 'Die Wichtigsten Deutschen Seehandelstädte,' p. 23. Stuttgart: 1901.

and economic development of the colonizers as reflected in their valuation of territorial area. The first phase, the outcome of a low estimate of the value of land, is best represented by the Phœnician and earliest Greek colonies, whose purposes were chiefly commercial, and who sought merely such readily accessible coastal points as furnished the best trading stations on the highway of the Mediterranean and the adjacent seas.* The earlier Greek colonies, like those of the Triopium promontory forming the south-western angle of Asia Minor, Chalcidice, the Thracian Chersonesus, Calchedon, Byzantium, the Pontic Heraclea, and Sinope, were situated on peninsulas or headlands, that would afford a convenient anchor ground; or, like Syracuse and Mitylene, on small inshore islets, which were soon outgrown, and from which the towns then spread to the mainland near by.† The advantages of such sites lay in their accessibility to commerce, and in their natural protection against the attack of strange or hostile mainland tribes. For a nation of merchants, satisfied with the large returns but also with the ephemeral power of middlemen, these considerations sufficed. While the Phœnician trading posts in Africa dotted the outer rim of the coast, the inner edge of the zone was indicated by Libyan or Ethiopian towns, where the inhabitants of the interior bartered their ivory and skins for the products of Tyre.‡ So that commercial expansion of the Arabs down the east coast of Africa in the tenth century seized upon the offshore islands of Zanzibar, Pemba, and Mafia, the small inshore islets like Mombasa and Lamu, and the whole outer rim of the coast from the equator southward to the Rovuma river; nor had the sultan's territory expanded a decade ago, when he had to relinquish the long thread of his continental possessions.

But when a people has advanced to a higher conception of colonization as an outlet for national as well as commercial expansion, and when it sees that the permanent prosperity of both race and trade in the new locality depends upon the occupation of larger tracts of territory and the development of local resources as a basis for exchanges, their settlements spread from the outer rim of the coasts to its inner edge and yet beyond, if alluvial plains and river highways are present as lures into the interior. Such was the history of many later colonies of the Greeks and Carthaginians,§ and especially of most modern colonial movements, for these have been dominated by a higher estimate of the value of land.

After the long Atlantic journey, the outposts of the American coast were welcome resting-places to the early European voyagers, but, owing to their restricted area and therefore limited productivity, they were soon abandoned, or became mere bases for inland expansion. The little

* Grote, 'History of Greece,' vol. 3, p. 179. New York: 1857.

† Ibid., vol. 3, pp. 194 and 363.

‡ Ibid., vol. 3, p. 273.

§ Ibid., vol. 3, pp. 195, 197, 275.

island of Cuttyhunk, off southern Massachusetts, was the site of Gosnold's abortive attempt at colonization in 1602, like Raleigh's attempt on Roanoke island in 1585, and the later one of Popham on the eastern headland of Casco bay. The Pilgrims paused at the extremity of Cape Cod, and again on Clark's island, before fixing their settlement on Plymouth bay. Monhegan island, off the Maine coast, was the site of an early English trading post, which, however, lasted only from 1623 to 1626; * and the same dates fix the beginning and end of a fishing and trading station established on Cape Ann, and removed later to Salem harbour. The Swedes made their first settlement in America on Cape Henlopen, at the entrance of Delaware bay; but their next, only seven years later, they located well up the estuary of the Delaware river. Thus for the modern colonist the outer edge of the coast is merely the gateway of the land; from it he passes rapidly to the settlement of the interior, wherever fertile soil and abundant resources promise a due return upon his labour.

Since it is from the land, as the inhabited portion of the Earth's surface, that all maritime movements emanate, and to the land that all oversea migrations are directed, the reciprocal relations between land and sea are largely determined by the degree of accessibility existing between the two. This depends primarily upon the articulation of a land mass, whether it presents an unbroken contour like Africa and India, or whether, like Asia and Norway, it drops a fringe of peninsulas and a shower of islands into the bordering ocean. Mere distance from the sea bars a country from its vivifying contact; every protrusion of an ocean artery into the heart of a continent makes that heart feel the pulse of life on far-off unseen shores. The Baltic inlet which makes a seaport of St. Petersburg 800 miles (1300 kilometres) back from the western rim of Europe, brings Atlantic civilization to this half-Asiatic side of the continent. The solid front presented by the Iberian peninsula and Africa to the Atlantic has a narrow crack at Gibraltar, whence the Mediterranean penetrates inland 2300 miles (3700 kilometres), and converts the western foot of the Caucasus and the roots of the Lebanon mountains into a seaboard. By means of the Arabian sea, the Indian ocean runs northward 1300 miles (2200 kilometres) from Cape Comorin to meet the Indus delta; and then turns westward 700 miles farther through the Oman and Persian gulfs to receive the boats from the Tigris and Euphrates. Such marine inlets create islands and peninsulas, which are characterized by proximity to the sea on all or many sides, and in the interior of the continents produce every degree of nearness shading off into inaccessible remoteness from the watery highway of the deep.

The success with which such indentations open up the interior of the continents depends upon the length of the inlets and the size of the

* W. B. Weedon, 'Economic and Social History of New England,' vol. 1, p. 98. Boston 1899.

land mass in question. Africa's huge area and unbroken contour combine to hold the sea at arm's length; Europe's deep-running inlets open that small continent so effectively that Kazan, Russia's most eastern city of considerable size, is only 750 miles (1200 kilometres) distant from the nearest White sea, Baltic, and Azof ports. Asia, the largest of all the continents, despite a succession of big indentations that invade its periphery from Sinai peninsula to East Cape, has a vast inland area hopelessly far from the surrounding oceans.

In order to determine the coast articulation of any country or continent, Carl Ritter and his followers divided area by shoreline, the latter a purely mathematical line representing the total contour length. By this method Europe's ratio is 1 linear mile of coast to 174 square miles of area, Australia's 1:224, Asia's 1:490, and Africa's 1:700. This means that Europe's proportion of coast is three times that of Asia and four times that of Africa; that a country like Norway, with a shoreline of 12,000 miles traced in and out along the fiords and around the larger islands,* has only 10 square miles of area for every mile of seaboard, while Germany, with every detail of its littoral included in the measurement, has only 1515 miles of shoreline and a ratio of 1 mile of coast to every 159 square miles of area.

The criticism has been made against this method that it compares two unlike measures, square and linear, which moreover increase or decrease in markedly different degrees, according as larger or smaller units are used. But for the purposes of anthropogeography the method is valid, inasmuch as it shows the amount of area dependent for its marine outline upon each mile of littoral. A coast, like every other boundary, performs the important function of intermediary in the intercourse of a land with its neighbours; hence the length of this sea boundary materially affects this function. Surface and periphery are not dead mathematical quantities, but organs of one body which stand in close reciprocal activity, and which can be understood only in the light of their persistent mutual relations. The division of the area of a land by the length of its coastline yields a quotient which to the anthropogeographer is not a dry figure, but an index to the possible relations between seaboard and interior. A comparison of some of these ratios will illustrate this fact.

Germany's shoreline, traced in contour without including details, measures 787 miles; this is just one-fifth that of Italy and two-fifths that of France, so that it is short. But since Germany's area is nearly twice Italy's and a little larger than that of France, it has 267 square miles of territory for every mile of coast, while Italy has only 28 square miles, and France 106. Germany has towns that are 434 miles from the nearest seaboard, but in Italy the most inland point is only 148 miles

* Norway, Official Publication for the Paris Exhibition, p. 1. Christiania, 1900.
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from the Mediterranean.* If we turn now to the United States and adopt Mendenhall's estimate of its general or contour coastline as 5705 miles, we find that our country has 530 square miles of area dependent for its outlet upon each mile of seaboard. This means that our coast has a heavy task imposed upon it, and that its commercial and political importance is correspondingly enhanced; that the extension of our Gulf of Mexico littoral by the purchase of Florida and the annexation of Texas was a measure of self-preservation, and that the unbroken contour and mountain-walled face of our Pacific littoral is a serious national handicap.

But this method is open to the legitimate and fundamental criticism that, starting from the conception of a coast as a mere line instead of a zone, it ignores all those features which belong to every littoral as a strip of the Earth's surface—location, geologic structure, relief, slope, accessibility to the sea in front and to the land behind, all which vary from one part of the world's seaboard to another, and serve to differentiate the human history of every littoral. Moreover, of all parts of the Earth's surface, the coast as the hem of the sea and land, combining the characters of each, is most complex. It is the coast as a human habitat that primarily concerns anthropogeography; and a careful analysis of the multifarious influences modifying one another in this mingled environment of land and water reveals an intricate interplay of geographic forces, varying from inland basin to marginal sea, from marginal sea to open ocean, and changing from one historical period to another—an interplay so mercurial that it could find only a most inadequate expression in a rigid mathematical formula.

As the coast, then, is the border zone between the solid, inhabited land and the mobile, untenanted deep, two important factors in its history are the accessibility of its back country on the one hand, and the accessibility of the sea on the other. A littoral barred from its hinterland by mountain range or steep plateau escarpment or desert tract feels little influence from the land; level or fertile soil is too limited in amount to draw inland the growing people, intercourse is too difficult and infrequent, transportation too slow and costly. Hence the inhabitants of such a coast are forced to look seaward for their racial and commercial expansion, even if a paucity of good harbours limits the accessibility of the sea, and to lead a somewhat detached and independent existence, so far as the territory behind them is concerned. Here the coast, as a peripheral organ of the interior, as the outlet for its products, the market for its foreign exchanges, and the medium for intercourse with its maritime neighbours, sees its special function impaired. But it takes advantage of its isolation and the protection of a long sea boundary to detach itself politically from its hinterland, as

* Friedrich Ratzel, 'Deutschland,' pp. 150, 151. Leipzig: 1898.

the history of Phœnicia, the *Ægean* coast of Asia Minor, Dalmatia, the republics of Amalfi, Venice, and Genoa, the county of Barcelona, and Portugal abundantly prove; and at the same time it profits by its sea-board location to utilize the more varied fields of maritime enterprise before it, in lieu of the more or less forbidden territory behind it. The height and width of the landward barrier, the number and practicability of the passways across it, and especially the value of the hinterland's products in relation to their bulk, determine the amount of intercourse between that hinterland and its mountain or desert barred littoral.

The interior is most effectively cut off from the periphery, where a mountain range or a plateau escarpment traces the inner line of the coastland, as in the province of Liguria in northern Italy, Dalmatia, the western side of the Indian peninsula, most parts of Africa, and long stretches of the Pacific littoral of the Americas. The highland that backs the Norwegian coast is crossed by only one railroad, that passing through the Trondhjem depression; and this barrier has served to keep Norway's historical connection with Sweden far less intimate than with Denmark. The long inlet of the Adriatic, bringing the sea well into the heart of Southern Europe, has seen nevertheless a relatively small maritime development, owing to the wall of mountains that everywhere shuts out the hinterland of its coasts. The greatness of Venice was intimately connected with the Brenner pass over the Alps on the one hand, and the trade of the eastern Mediterranean on the other. Despite Austro-Hungary's crucial interest in the north-east corner of the Adriatic as a maritime outlet for this vast inland empire, and its herculean efforts at Trieste and Fiume to create harbours and to connect them by transmontane railroads with the valley of the Danube, the maritime development of this coast is still restricted, and much of Austria's trade goes out northward by German ports.* Farther south along the Dalmatian and Albanian coasts, the deep and sheltered bays between the half-submerged roots of the Dinaric Alps have developed only local importance, because they lack practicable connection with the interior. This was their history too in early Greek and Roman days, for they found only scant support in the few caravans that crossed by the Roman road to Dyrrachium to exchange the merchandise of the *Ægean* for the products of the Ionian isles. Spain has always suffered from the fact that her bare, arid, and unproductive tableland almost everywhere rises steeply from her fertile and densely populated coasts; and therefore that the two have been unable to co-operate either for the production of a large maritime commerce or for natural political unity. Here the diverse conditions of the littoral and the wall of the great central terrace of the country have emphasized that tendency to defection that belongs

* Joseph Partsch, 'Central Europe,' pp. 227-230. London: 1903

to every periphery, and therefore necessitated a strong centralized government to consolidate the restive maritime provinces with their diverse Galician, Basque, Catalanian, and Andalusian stocks into one nation with the Castilians of the plateau.*

Where mountain systems run out endwise into the sea, the longitudinal valleys with their drainage streams open natural highways from the interior to the coast. This structure has made the Atlantic side of the Iberian peninsula far more open than its Mediterranean front, and therefore given that western face the lead in maritime affairs since 1450. So from the shores of Thrace to the southern point of the Peloponnesus, all the valleys of Greece open out on the eastern or Asiatic side; here every mountain-flanked bay has had its own small hinterland to draw upon, and every such interior has been accessible to the civilization of the *Ægean*; here was concentrated the maritime and cultural life of *Hellas*.† The northern half of Andean Colombia, by way of the parallel Atrato, Rio Cauco, and Magdalena valleys, has supported the activities of its Caribbean littoral, and through their avenues has received such foreign influences as might penetrate to inland Bogota. In like manner, the mountain-ridged peninsula of Farther India keeps its interior in touch with its leading ports through its intermontane valleys of the Irawadi, Salwin, Menam, and Mekong rivers.

Low coasts rising by easy gradients to wide plains, like those of northern France, Germany, southern Russia, and the Gulf seaboard of the United States, profit by an accessible and extensive hinterland. Occasionally, however, this advantage is curtailed by a political boundary reinforced by a high protective tariff, as Holland, Belgium, and East Prussia know to their sorrow.

These low hems of the land, however, often meet physical obstructions to ready communication with the interior in the silted inlets, shallow lagoons, marshes, or mangrove swamps of the littoral itself. Here the larger drainage streams give access through this amphibian belt to the solid land behind. Where they flow into a tide-swept bay like the North sea or the English channel, they scour out their beds and preserve the connection between sea and land; but debouchment into a tideless basin like the Caspian or the Gulf of Mexico, even for such mighty streams as the Volga and the Mississippi, sees the slow silting up of their mouths and the restriction of their agency in opening up the hinterland. Thus the character of the bordering sea may help to determine the accessibility of the coast from the land side.

Its accessibility from the sea depends primarily upon its degree of articulation; and this articulation depends upon whether the littoral

* Elisée Reclus, 'The Earth and its Inhabitants: Europe,' vol. 1, pp. 370-372. New York: 1882.

† Ernst Curtius, 'History of Greece,' vol. 1, pp. 15-20. New York.

belt has suffered elevation or subsidence. When the inshore sea rests upon an uplifted bottom, the contour of the coast is smooth and unbroken, because most of the irregularities of surface have been overlaid by a thick deposit of waste from the land; so it offers no harbour except here and there a silted river mouth, while it shelves off through a broad amphibian belt of tidal marsh, lagoon, and sand reef to a shallow sea. Such is the coast of New Jersey, most of the Gulf seaboard of the United States and Mexico, the Coromandel coast of India, and the long, low littoral of Upper Guinea. Such coasts harbour a population of fishermen living along the strands of their placid lagoons,* and stimulate a timid inshore navigation which sometimes develops to extensive coastwise intercourse, where a network of lagoons and deltaic channels forms a long inshore passage, as in Upper Guinea, but which fears the break of the surf outside.†

The rivers draining these low uplifted lands are deflected from their straight path to the sea by coastwise deposits, and idly trail along for miles just inside the outer beach; or they are split up into numerous offshoots among the silt beds of a delta, to find their way by shallow, tortuous channels to the ocean, so that they abate their value as highways between sea and land. The silted mouths of the Nile excluded the larger vessels even of Augustus Cæsar's time and admitted only their lighters,‡ just as to-day the lower Rufigi river loses much of its value to German East Africa because of its scant hospitality to vessels coming from the sea.

The effect of subsidence, even on a low coastal plain, is to increase accessibility from the sea by flooding the previous river valleys and transforming them into a succession of long shallow inlets, alternating with low or hilly tongues of land. Such embayed coasts form our Atlantic seaboard from Delaware bay, through Chesapeake bay to Pamlico sound, the North sea side of England, the funnel-shaped "fürden" or firths on the eastern side of Jutland and Schleswig-Holstein, and the ragged sounds or "Bodden" that indent the Baltic shore of Germany from the Bay of Lubeck to the mouth of the Oder river.§ Although the shallowness of the bordering sea and the sand-bars and sand reefs which characterize all flat coasts here also exclude the largest vessels, such coasts have nevertheless ample contact with both land and sea. They tend to develop, therefore, the activities appropriate to both. A fertile soil and abundant local resources, as in tidewater Maryland and Virginia, makes the land more attractive than

* William Morris Davis, 'Physical Geography,' pp. 115-122. 1899.

† Frederick Ratzel, 'History of Mankind,' vol. 3, p. 95. London: 1898.

‡ Strabo, book xvii. ch. i. 18. Diodorus Siculus, book i. ch. iii. p. 36. Translated by G. Booth. London: 1811.

§ J. Partsch, 'Central Europe,' pp. 90-98. London: 1903. F. Ratzel, 'Deutschland,' pp. 143-144. Leipzig: 1898.

the sea; the inhabitants become farmers rather than sailors. On the other hand, an embayed coastland promising little return to the labour of tillage, but with abundant fisheries and a superior location for maritime trade, is sure to profit by the accessible sea, and achieve the predominant maritime activity which characterized the mediæval Hanse Towns of northern Germany and our colonial New England.

Subsidence that brings the beat of the surf against the bolder reliefs of the land produces a ragged, indented coast, deep-water inlets penetrating far into the country, hilly or mountainous tongues of land running far out into the sea and breaking up into a swarm of islands and rocks, whose outer limits indicate approximately the old prediluvial line of shore.* Such are the fiord regions of Norway, southern Alaska, British Columbia, Greenland, and southern Chili; the Rias or submerged river valley coast of north-western Spain; and the deeply sunken mountain flank of Dalmatia, whose every lateral valley has now become a bay or a strait between mainland and island. All these coasts are characterized by a close succession of inlets, a limited amount of level country for settlement or cultivation, and in their rear a steep slope impeding communication with their hinterland. Inaccessibility from the land, a high degree of accessibility from the sea, and a paucity of local resources unite to thrust the inhabitants of such coasts out upon the deep, to make of them fishermen, seamen, and ocean carriers. The same result follows where no barrier on the land side exists, but where a granitic or glaciated soil in the interior discourages agriculture and landward expansion, as in Brittany, Maine, and Newfoundland. In all these the land repels and the sea attracts. Brittany furnishes one-fifth of all the sailors in France's merchant marine,† and its pelagic fishermen sweep the seas from Newfoundland to Iceland. Three-fifths of the maritime activity of the whole Austrian Empire is confined to the ragged coast of Dalmatia, which furnishes to-day most of the sailors for the imperial marine, just as in Roman days she manned the Adriatic fleet of the Cæsars.‡ The Haida, Tsimshian, and Thlingit Indians of the ragged western coast of British Columbia and southern Alaska spread their villages on the narrow tide-swept hem of the land, and subsist chiefly by the generosity of the deep. They are poor landmen, but excellent boat-makers and seamen, venturing sometimes 25 miles out to sea to gather birds' eggs from the outermost fringe of rocks.

As areas of elevation or subsidence are, as a rule, extensive, it follows that coasts usually present long stretches of smooth simple shoreline, or a long succession of alternating inlet and headland. Therefore different littoral belts show marked contrasts in their degree of accessibility to

* For geomorphology of coasts, see William Morris Davis, 'Physical Geography,' pp. 112-136, 347-388. Boston: 1899.

† Elisée Reclus, 'The Earth and its Inhabitants: Europe,' vol. 2, p. 252.

‡ J. Partsch, 'Central Europe,' p. 231. London: 1903.

the sea, and their harbours appear in extensive groups of one type—fiord, river estuaries, sand or coral reef lagoons, and embayed mountain roots. A sudden change in relief or in geologic history sees one of these types immediately succeeded by a long-drawn group of a different type. Such a contrast is found between the Baltic and North sea ports of Denmark and Germany, the eastern and southern seabords of England, the eastern and western sides of Scotland, and the Pacific littoral of North America north and south of Juan de Fuca strait.

A common morphological history, marked by mountain uplift, glaciation, and subsidence, has given an historical development similar in not a few respects to the fiord coasts of New England, Norway, Iceland, Greenland, the Alaskan "panhandle," and southern Chile. So large subsidence areas on the Mediterranean coasts from the Strait of Gibraltar to the Bosphorus have in essential features duplicated each other's histories, just as the low infertile shores of the Baltic from Finland to the Skager Rack have had much in common in their past development.

Where, however, a purely local subsidence, as in Kamerun bay and Old Calabar on the elsewhere low monotonous stretch of the Upper Guinea coast,* or a single great river estuary, as in the La Plata and the Columbia, affords a protected anchorage on an otherwise portless shore, such inlets assume increased importance. In the long unbroken reach of our Pacific seaboard, San Francisco bay and the Columbia estuary are of inestimable value; while, by the treaty of 1848 with Mexico, the international boundary line was made to bend slightly south of west from the mouth of the Gila river to the coast, in order to include in the United States territory the excellent harbour of San Diego. The mere nicks in the rim of South-West Africa constituting Walfish bay and Angra Pequena assume considerable value as trading stations and places of refuge along that 1200-mile reach of inhospitable coast extending from Cape Town north to Great Fish bay.† It is worthy of notice in passing that, though both of these small inlets lie within the territory of German South-West Africa, Walfish bay with 20 miles of coast on either side is a British possession, and that two tiny islets which command the entrance to the harbour of Angra Pequena, also belong to Great Britain. On the uniform coast of East Africa, the single considerable indentation formed by Delagoa bay assumes immense importance, which, however, is due in part to the mineral wealth of its Transvaal hinterland; but from this point northward for 35° of latitude, a river mouth, like that fixing the site of Beira, or an inshore islet affording protected harbourage, like that of Mombasa, serves as the single ocean gateway of a vast territory, and forms the terminus of a railroad—proof of its importance.

* G. G. Chisholm, 'Commercial Geography,' pp. 444, 448. London: 1904.

† H. R. Mill, 'International Geography,' p. 1012. New York: 1902. Hereford George, 'Historical Geography of the British Empire,' pp. 278-279. London: 1904.

The maritime evolution of all amply embayed coasts, except in Arctic and sub-Arctic regions inimical to all historical development, shows in its highest stage the gradual elimination of minor ports, and the concentration of maritime activity in a few favoured ones, which have the deepest and most capacious harbours and the best river, canal, or railroad connection with the interior. The earlier stages are marked by a multiplicity of ports, showing in general activity nearly similar in amount and in kind. England's merchant marine in the fourteenth century was distributed in a large group of small but important ports on the southern coast, all which, owing to their favourable location, were engaged in the French and Flemish trade; and in another group on the east coast, reaching from Hull to Colchester, which participated in the Flemish, Norwegian, and Baltic trade.* Most of these have now declined before the overpowering competition of a few such seaboard marts as London, Hull, and Southampton; the introduction of steam trawlers into the fishing fleets has in like manner led to the concentration of the fishermen in a few large ports with good railroad facilities, such as Aberdeen and Grimsby, while the fishing villages that fringed the whole eastern and southern coasts have been gradually depopulated.† So in colonial days, when New England was little more than a cordon of settlements along that rock-bound littoral, almost every inlet had its port actively engaged in coastwise and foreign commerce in the West Indies and the Guinea Coast, in cod and mackerel fisheries, in whaling and shipbuilding, and this with only slight local variations.‡ This widespread homogeneity of maritime activity has been succeeded by strict localization and differentiation, and reduction from many to few ports. So, for the whole Atlantic seaboard of the United States, evolution of seaports has been marked by increase of size attended by decrease of numbers.

A well dissected coast, giving ample contact with the sea, often fails nevertheless to achieve historical importance, unless outlying islands are present to ease the transition from inshore to pelagic navigation, and to tempt to wider maritime enterprise. The long sweep of the European coast from northern Norway to Brittany has played out a significant part of its history in that procession of islands formed by Iceland, the Færoes, Shetland, Orkneys, Great Britain, and the Channel isles, whether it was the navigator of ancient Armorica steering his leather-sailed boat to the shores of Caesar's Britain, or the modern Breton fisherman pulling in his nets off the coasts of distant Iceland. The dim outline of mountainous Cyprus, seen against a far-away horizon from the slopes of

* J. E. Thorold Rogers, 'Six Centuries of Work and Wages,' pp. 123-124. New York: 1884.

† H. R. Mill, 'International Geography,' p. 148. New York: 1902.

‡ Ellen C. Semple, 'American History and its Geographic Conditions,' pp. 121-128. Boston: 1903.

Lebanon, beckoned the Phœnician ship-master thither to trade and to colonize, just as the early Etruscan merchants passed from their busy ironworks on the island of Elba over the narrow strait to visible Corsica.* It was on the eastern side of Greece, with its deep embayments, its valleys opening out to the Ægean, with its 483 islands scattered thickly as stars in the sky, and its Milky Way of the Cyclades leading to the deep, rich soils of the Asia Minor coast, with its sea-made contact with all the stimulating influences and dangers emanating from the Asiatic littoral, that Hellenic history played its impressive drama. Here was developed the spirit of enterprise that carried colonies to far western Sicily and Italy,† while the western or rear side had a confined succession of local events, scarce worthy the name of history. Neither mountain-walled Epirus nor Corcyra had a Hellenic settlement in 735 B.C., at a date when the eastern Greeks had reached the Ionian coast of the Ægean and had set up a lonely group of colonies even on the Bay of Naples. Turning to America, we find that the Antilles received their population from the only two tribes, first the Aruacs and later the Caribs, who ever reached the indented northern coast of South America between the Isthmus of Panama and the mouth of the Orinoco. Here the small islands of the Venezuelan coast, often in sight, lured these peoples of river and shore to open-sea navigation, and drew them first to the Windward isles, then northward step by step or island by island, to Hayti and Cuba.‡

In all these instances, offshore islands tempt to expansion and thereby add to the historical importance of the near-by coast. Frequently, however, they achieve the same result by offering advantageous footholds to enterprising voyagers from remote lands, and become the medium for infusing life into hitherto dead coasts. The long monotonous littoral of East Africa from Cape Guadafui to the Cape of Good Hope, before the planting here of Portuguese way-stations on the road to India in the sixteenth century, was destitute of historical significance, except that stretch opposite the islands of Zanzibar and Pemba, which Arab merchants in the tenth century appropriated as the basis for their slave and ivory trade. So the long gentle curve of the East Indies have been so many off-shore stations whence, first through the Portuguese, and later through the Dutch, European influences percolated into South-Eastern Asia. Asia, with its island-strewn shores, has diffused its influences over a broad zone of the western Pacific, and through the agency of its active restless Malays, even halfway across that ocean. In contrast, the western coast of the Americas, a stretch nearly 10,000 miles from Tierra

* Diodorus Siculus, book v. ch. i. p. 304. Translated by G. Booth. London: 1814. Strabo, book v. ch. vi. 6, 7.

† Grote, 'History of Greece,' vol. 3, pp. 357, 360-366. New York: 1857.

‡ Hans Helmolt, 'History of the World,' vol. 1, pp. 188-189, 193-195. New York 1902.

del Fuego to the Aleutian chain, has seen its aboriginal inhabitants barred from seaward expansion by the lack of offshore islands, and its entrance upon the historical stage delayed till recent times.

In general it can be said that islandless seas attain a later historical development than those whose expanse is rendered less forbidding by hospitable fragments of land. This factor, as well as its location remote from the old and stimulating civilization of Syria and Asia Minor, operated to retard the development of the western Mediterranean long after the eastern basin had reached its zenith; but in this eastern basin, again, the paucity of islands and unbroken contour of its southern half gave a meagre history to all its shores lying south of Cyprus, Crete, and Malta.

(To be continued.)

REVIEWS.

ASIA.

A JOURNEY IN NORTH-EASTERN TIBET.

'Das Rätsel des Matschu. Meine Tibet Expedition.' Von Wilhelm Filchner. *Maps and Illustrations.* Berlin: Mittler. 1907.

'Das Kloster Kumbum in Tibet.' By the same. *Maps and Illustrations.* Berlin: Mittler. 1906.

'Wissenschaftliche Ergebnisse der Expedition Filchner nach China und Tibet, 1903-05.' X. Band, I. Teil. Berlin: Mittler. 1908.

THE journey of which these works are the outcome was in many ways a remarkable one. It was undertaken, not for mere purposes of sport or adventure, but with a fixed determination on the part of the author to achieve a piece of work which it might take all his manhood to accomplish. Having set himself a definite task, he spared no pains to qualify himself for its execution, and allowed no difficulties to deter him from carrying it through when begun. The chosen field was, as he claims, at the time of his setting out, the most important unknown area in the whole of interior Asia—that traversed by the upper course of the Hwang-ho, and stretching southward from this towards the mountainous border of northern Szechuan; and, although unable to carry out every part of his programme, he was successful in stretching a line of survey across the very centre of this little-trod region.

Lieut. Filchner had the advantage of two zealous coadjutors in his work. His wife—who accompanied him to the threshold of Tibet, and during his further journey spent an anxious time of waiting in the family of Mr. Ridley, an English missionary at Sining-fu—gave substantial help in the formation of the botanical, zoological, and ethnological collections, besides keeping up a regular series of meteorological observations during her residence at Sining. His other companion, Dr. Tafel, whose own recent journey has been frequently referred to in these pages, undertook the geological researches, and was able to bring together a large collection of rock-specimens. The leader himself was fully occupied with the route survey, astronomical determination of positions, altitude determinations, meteorological observations made three times daily, magnetic observations at forty-two stations, and photographic work, besides botanical and zoological collections. The working up of all this material has been a task of considerable magnitude, but being attached (through the influence of the late Baron von Richthofen, a constant supporter of the

whole undertaking) to the trigonometrical division of the general staff at Berlin, Lieut. Filchner enjoyed special facilities and expert co-operation in carrying it through. The more serious results will eventually occupy a number of volumes, of which two have so far appeared, while a general narrative is supplied in the first of the works above recorded.

The story told in this volume cannot fail to rivet the reader's attention, especially in the Tibetan portion, where the fate of the party and the success or failure of the venture seem throughout to be hanging in the balance. The route across China, though necessarily of less dramatic interest, was far less hackneyed than many that have been described of late years. It led up the swiftly flowing Han river (where the German traveller seems to have preceded Colonel Manifold's party by a few weeks only) to Hingan-fu; across the rugged Chin-ling or Tsin-ling range to Sian-fu; and thence *via* Lan-chou to Sining-fu, where the final organization of the Tibetan expedition took place. The journey was comparatively uneventful until the upper Hwang-ho (Tibetan Machu) was reached, but here the real troubles began. It was found impossible to cross the river, in spite of several gallant attempts by Dr. Tafel to swim across with a rope, and it was necessary to ascend it almost to its outlet from the Oring-nor. The country of the dreaded Ngolok, into which the expedition was about to venture, lay on the farther side, but as it was hoped to disguise from these the presence of Europeans in the caravan, it was decided to make a southward *détour* so as to approach the Ngolok country from the direction of Lhasa. This ruse was hardly a success, for the party were viewed with more or less suspicion from the first, and the time that followed was one of unceasing anxiety. There is something almost farcical in the account of the travellers' distresses. Their disguise (or at least that of Lieut. Filchner) seems to have been of the flimsiest nature, yet we find them endeavouring to keep it up after being frequently denounced as Europeans; driven at times to hiding in their tents, and allowing their servants to pose as the owners of the caravan, or having desperate recourse to a story that their boxes were filled with soldiers armed to the teeth. Although in certain cases they were received with unexpected hospitality, a state of more or less open hostility was the rule, and on the occasion of a night attack, they had to stand to be fired at for hours, at a temperature many degrees below freezing. Yet, though constantly in the power of the Ngolok, these show a strange reluctance to proceed to extremities, and when at last they are made prisoners by the chief of Waserr, they find in their captor a friend who materially assists them in completing their undertaking. A great part of their difficulties seems to have arisen from the total lack of sympathy between the Europeans and their Chinese followers, and one is tempted to ask whether an open avowal of their true character might not have been after all the better policy.

During this journey the Machu was followed with great determination almost to its great northerly bend, when its banks became quite impracticable. Even at this early stage, the river is remarkable for the amount of sand it carries down. Lieut. Filchner was untiring in carrying on his surveys, and his success as a photographer is shown by the exceptionally good views of the country traversed. The people themselves and the objects in use among them are also well illustrated. The Ngolok seem a typical race of steppe-dwellers, though there are some large and (for the nature of the country) dense aggregations of population. They are described as born soldiers, with a keen eye for country, and as possessing more character and independence than their Chinese neighbours. Some trade is carried on amongst them by Chinese Mohammedan merchants, with whom the travellers frequently came in contact. The maps in the volume are very rough, but the cartographical results are to be published separately.

In his volume on the Kumbum monastery—the first of the special monographs on the results of the journey—Lieut. Filchner gives the most complete account that has yet appeared of its present condition and its history. The other volume above referred to describes the zoological and botanical collections.

CENTRAL ASIA.

'In the Footsteps of Marco Polo: Being the Account of a Journey Overland from Simla to Pekin.' By Major C. D. Bruce, late Commanding the Chinese Regiment of Infantry. Edinburgh and London: William Blackwood & Sons. 1907.

This interesting description of a long and, in places, rough journey deserves and we hope will obtain, considerable popularity, for it appeals to all sorts and conditions of men. To geographers because, as often as was possible, an untrodden or little-known route was selected, and the countries visited from the desert of Takla Makan onward have at present, for such persons, special interest. History readers will find much information respecting Buddhism; Chinese intercourse with India, Tibet, and Turkistan; and the ancient history of China. Others more interested in the present than in the past, will find a great coalfield in Kansu described. Baron von Richthofen has said that it was one of the most remarkable in the world, but had two great disadvantages: distance from the sea or navigable rivers, and being situated a few thousand feet above the adjoining plain. English enterprise, if not thwarted by Chinese prejudice and obstruction, might surely be equal to finding a profitable solution.

Again, that strange deposit, so interesting to students of physical geography, known as the loess formation, was met, and a long description of it by Baron v. Richthofen is quoted. The relations between the three empires chiefly concerned in Central Asia, the policy followed, and other matters, are touched on with commendable restraint. In this volume, therefore, there is no want of food to suit many tastes.

Major Bruce makes some sound remarks on the religion of Ladakh; he says, "The Ladakis who inhabit this country differ considerably from the Kashmiris. The former profess Buddhism, but, be it said at once, a form which bears hardly any resemblance to the elevating and mystic faith which Buddha once taught.

"The actual religion of Ladak is a modified form of Indian Buddhism, and was introduced more than two thousand years ago. It is contained in a voluminous work called the 'Kah-Gyur,' or 'Translation of Precepts,' because it is a version of the precepts of 'Sakya' made from the Indian language."

He gives further particulars, and mentions a mission from Leh to Lhasa "known as the Lapchack Mission." It is of old standing, and is sent every third year, and was payment of tribute as well as a commercial enterprise. Now the British authorities consider it has no political signification, but that view is probably not held by the Tibetan rulers, who regard it as *nazar*, or tribute. The distinction, as matters now stand, is unimportant, but if ordinary advantage had been taken of the Younghusband mission, the British Government would have been, sooner or later, the protecting power; thus at the same time assuming superiority, and, through Kashmir, paying tribute; a situation savouring of comic opera.

The journey of Major Bruce's party may be divided into three main parts: from Simla to the Tibetan frontier at the top of the Lanak pass, Chang Chenmo valley; thence *via* Kiria to Su-chau, the first town met in China proper; and from Su-chau to Peking. The first part calls for no special notice, but there is much interest at present felt in the second part. For not only is the question of the battle between the sands of the desert and the water from the snows involved, but recent archaeological research, chiefly under Dr. M. Aurel Stein, happily still in progress, has

brought to light many manuscripts and relics which are expected to throw light on matters more or less obscure. Of the boundaries of this tract the major says, "The geographical area commonly known as Chinese Turkestan is a somewhat vague one. By some geographers it is considered to embrace the larger portion of the western extra-mural Chinese Empire. By others the area so described is confined to the basins drained by the streams which run into Lopnor, as well as by those which lose themselves in the great central desert, the Takla Makan."

"From the Chinese point of view the latter are more nearly correct, the territory being always known to the people of that vast empire as the Hsing Chiang, or new frontier."

Whilst travelling along the southern side of the Takla Makan some sport, of which there is an animated description, was had about Nia, and the fact of passing to the south of the terminal lake of the combined waters from both sides of the desert has led to remarks on the Lob-nor controversy. That is, we hope, practically set at rest by the explanation that the lake is and was a changing and migrating body of water, and that now, not improbably, it is returning to the old site, as shown in ancient Chinese records.*

In instances the names in the text do not agree with those in the maps, in which Umrutsi is found for Urumsî; but on the whole the book is fairly free from misprints, and is well turned out.

W. BROADFOOT.

A DUTCH VOYAGE IN THE PERSIAN GULF.

'Cornelis Cornelisz Roobacker's Scheeps-Journaal, Ganiron-Basra (1645); de eerste Reis der Nederlanders door de Perzische Golf.' Edited by A. Hotz. Leiden: Brill. 1907.

In 1645 Willebrandt Geleynsz de Jongh, the President of the Dutch factories in Persia, decided to follow the example of the English in establishing a factory at Basra. Two small ships—the *Delfshaven* and the *Schelvish*—were accordingly despatched with a cargo of merchandise under the charge of Dirck Sarcerius. They sailed towards the end of June, reached their destination a month later, and landed their merchants, who, having obtained favourable terms from the Turkish governor, started their factory with every prospect of success. The *Delfshaven* sailed on her return voyage in September, and anchored at Gombroon on October 5. Her master, Cornelis Roobacker, had, of course, kept a careful journal of the voyage—the first undertaken by the Dutch in the Persian gulf—and this has now been printed by the Royal Geographical Society of the Netherlands. The original is missing, but use has been made of a transcript which was carried home by Geleynsz, and after his death passed, with others of his papers, into the possession of the municipal authority of Alkmaar, his birthplace. From their custody it was last year transferred to the Rijksarchief at the Hague.

The journal itself is of the usual character—a terse, straightforward narrative of the voyage, with special stress on matters relating to navigation. It has been admirably annotated by the editor, Mr. A. Hotz, who has also provided a copious and learned introduction, with a full list of books and maps dealing with the Persian Gulf and its trade. A special feature is the reproduction in facsimile of a contemporary chart of the Gulf—possibly by Roobacker himself—which is now in the library of Leiden University.

W. F.

* *Geogr. Journal*, vol. 27, p. 610.

AFRICA.

AFRICA FROM SOUTH TO NORTH.

'A Woman's Trek from the Cape to Cairo.' By Mary Hall. *With 64 Illustrations and two Maps.* Methuen & Co., London. 1907. *Price 16s. net.*

Miss Mary Hall is the first woman to have crossed Africa from south to north, and her account of how she managed to do it is not only well written, but full of useful information. A glance at her route as marked on the map shows that between Beira and Chinde the "trek" was by sea, and it appears that the journey was accomplished in two stages. In 1904 Miss Hall travelled extensively in South Africa; in 1905, starting from Chinde, she journeyed to Port Said by way of the great lakes and the Nile. She did not go as an explorer, or in furtherance of any scientific object such as zoology, or botany; simply as one who is interested in fresh countries and peoples, and considers travelling "the most delightful method of studying geography." Miss Hall has an observant eye, especially for the physical features of the countries through which she passes, and for the peoples with whom she comes in contact. Travelling through Nyasaland, through part of German East Africa, and also through Uganda to Gondokoro, as well as going down the Mombasa railway as far as Nairobi, she everywhere noted the progress being made by Europeans and the manner of life of the natives. There is probably no other book which gives so sympathetic yet accurate a picture of the condition of the regions named as is portrayed in Miss Hall's pages. This is interwoven with an account of her own adventures, the whole being set down without a trace of exaggeration. Miss Hall, on one of her *sojourns*, that between Usumbura on Lake Tanganyika and Bukoba on Victoria Nyanza, traversed country little known and inhabited by somewhat hostile tribes. Here, as elsewhere, she proved herself intrepid, resourceful, and tactful. Perhaps the most striking thing about the book, to the thoughtful reader, is the evidence it affords of the very great influence being exercised by the various Christian missions in East Equatorial Africa—and similar influence is being wielded in other parts of Negro and Bantu Africa. Miss Hall's testimony is that the work of the missionaries is not only beneficial, but fruitful. This is especially the case in Nyasaland and Uganda. One result is that over large areas native customs are fast being modified. To the ethnologists this change may be distasteful, but it should also stir him up to make greater efforts to study African culture before it is too late. For the rest we are thankful to get the views of a highly cultured woman on the tribes of Central Africa, and on the amenities of travel in realms still unhackneyed. Miss Hall ends her narrative at Khartum, and almost her last words are about General Gordon, and bear eloquent testimony to the indelible mark that remarkable man made upon the country which once he ruled. "A lady missionary," she writes, "a good Arabic scholar, told me that she had often heard the natives, as they stood beneath it [the statue of Gordon seated on a camel], talking to the great soldier and asking him why he did not come down and speak with them." There are numbers of excellent illustrations of native types, and two sketch-maps.

F. R. C.

AFRICAN LANGUAGES.

'Bantu Phonetics.' By the Rev. E. Jacottet. Lovedale Mission Press. 1907.

I believe I am correct in assuming that the author of this supplement to the *Christian Express* of September, 1907, is likewise the author of the grammar (in French) of the Subiya and Luyi languages of the upper Zambezi. This last-named work is one of the sanest and most illuminating studies of that fascinating subject—the Bantu languages, their origin and inter-relationship.

The supplement under review is little else than a summary and appreciation of three of Carl Meinhof's admirable linguistic studies—'Grundriss einer Lautlehre der Bantu-sprachen,' 'Grammatik des Tshi-venda,' and 'Hottentotische Laute, etc., im Kafir.' M. Jacottet, in his 'Bantu Phonetics,' does not do much more than reproduce with interesting comments the conclusions arrived at by Meinhof on the sound-changes of the Bantu languages. It is in this direction that the present writer (possibly through some defect in his own intelligence) feels the least cordial admiration for Meinhof's work. Meinhof is becoming one of the leading authorities on the structure, analogies, and relationships of the Bantu languages. He has revealed to our knowledge dialects or speech-groups scarcely if at all illustrated before. Some of his writings on the mysterious and hitherto unclassified East African languages, which are dotted in isolated enclaves amongst the Bantu languages in Eastern Equatorial Africa, are specimens of remarkable and illuminating research. But the "reviewer of this review" feels obliged to repeat here what he has said in the journal of another society, that, in his opinion, German philologists are wasting a certain amount of time and energy (besides confusing those less deeply instructed) by splitting hairs on the subject of variations in the pronunciation of consonants and vowels in the Bantu languages. They would like, for example, to distinguish between the different kinds of *t* in the Swahili language or in other forms of Bantu speech. They exasperate the reader's eye by unnecessary accents on vowels, attaching tremendous importance to the difference between *é* and *ê*. The letter *v* is marked above and below in all sorts of ways, because the German philologist has not the courage to call it a *b*. There is this kind of *k* and that kind of *k*. There are several sorts of *m* and *l* and *n*, of *r* and *g*. Now, the only result of this preciosity is that the exasperated beginner, or even the person who is halfway advanced in his African language-studies, lays down the German manual or grammar in despair. His mind cannot grapple with the infinitely varied instructions as to how to pronounce this consonant and that vowel. So he gives up (it may be) a study which is one of the most profound interest, because in the dissection and comparison of these Bantu languages is locked up a vast deal of unwritten African history.

The same plague in a more acute form—amounting, in fact, to a mania—affects the transliteration of North and South American languages. This affectation reached its highest development, perhaps, in the *Journal of the Royal Anthropological Institute* two or three years ago. There was one author (whose name I do not remember) whose transliteration of Alaskan languages was a masterpiece of mystification. Capital letters, lower-case letters turned upside down, weird accents, Greek letters, Arabic letters, German letters, were all (as it were) thrown into a hat, shaken up, and cast on to a page. In all probability, nobody but the author of the article would be able to pronounce and read the sounds he intended to describe.

Now, this is all vexatious nonsense, and it is time it was put a stop to. As a general rule, to which there are very few exceptions, every reasonable sound uttered by the human voice can be expressed by Lepsius' standard alphabet, and for ordinary purposes it is really not necessary even to go into the furthest refinements of Lepsius, except it be in some special manual intended to teach very accurately the exact pronunciation of a language.

Let this premise be admitted which I am about to express, and the whole of the Bantu languages can be written with the simplest form of the Lepsius alphabet, and that again, with a slight revision, is merely the Roman alphabet with one or two borrowed Greek letters. And the premise is this: that there is no doubt a good deal of variation—individual and tribal—in the exact pronunciation of consonants and vowels, of the letter *t* (for example). Sometimes the *t* is slightly

aspirated (as it is in a good many Indian words), sometimes it is pronounced in a *saccadé* fashion, as it is in the dialect of Glasgow. It easily crumbles into an *r* or softens into a *d*, and suddenly changes from *t* in one dialect to *s* or even *k* in another, closely related, and alongside. *R* and *l* interchange so constantly that they are practically the same letter. *R* and *d* take one another's place with the greatest facility; likewise *d* and *l*. It is often difficult to distinguish (when issuing from the mouth of a Bantu) *Dueru* from *Luelu*. The vowels permute also with some facility, though, as a rule, there is greater constancy in the life of vowel sounds than in the use of consonants. But take, for example, the Bantu for "shield." It is difficult to say whether in the original Bantu it was *ngubu* or *nguba*. In Kongo it is *Ngubu*, and in Swahili it is *Ngao*. In many other Bantu languages it is *ngabo*, and in yet many others it is *nguba*. *A* changes easily into *e*, *o* into *u*, *u* into *i*, and so on.

Amongst consonants, *g* often crumbles into *γ*, and *k* into *χ*, *ng* into *nd*, *nz*, or *nj*; *s* into *š*. *F* is frequently the rendering in one dialect of *sw* in another; or *f* takes the place of *h*, while *h* takes the place of *s*. Thus, the seventeenth prefix of North-West Bantu Africa seems to have been originally *si*, which has become in some districts *hi*, and then again *fi*, *vi*. As all these permutations can be easily proved by comparative tables, why bother about distinguishing the exact pronunciation of the letter *t* (for example)? If it sounds to you more like *r*, then write it *r*, and have done with it. If it is very strongly aspirated, then write it *th*; if it hisses like an *s*, then don't be upset, but transcribe it *s* or *ts*.

But I humbly submit that the attempt to discriminate too nicely between what each separate individual writer-down of these languages thinks to be the *exact* type of the *t*, *k*, *h*, *r*, *l*, or *d* as he hears it uttered in the not very clear enunciation of the sometimes savage instructor, has only the result of wasting a great deal of the learner's time and patience on what is not really essential to the study of new languages.

H. H. JOHNSTON.

AMERICA.

THE EVOLUTION OF MODERN CHILE.

'Chile. its History and Development,' etc. By G. F. Scott Elliot. London: T. Fisher Unwin. 1907. Pp. xxviii. and 364. *Maps and Illustrations.* Price 10s. 6d. net.

No story of the evolution of a South American Republic can possibly lack the interest of perpetual movement. The history of Chile, presented to us by Mr. Scott Elliot in a most attractive and readable form, is full of the romance of early conquest and the later struggles for independence which have fashioned the Chilean people into a self-reliant and enterprising nationality. The pageant of history moves by with its constant succession of national heroes, from the truculent Spanish soldiers of fortune who were first beguiled by the promise of gold into southern explorations from Peru, to the military statesmen of modern days who fought with Chilean hearts and English names for the building up of Chilean nationality. *Almagro* and *Valdivia*, and all the rest of the reckless adventurers of early Spanish conquest (when the search for material wealth was conducted on other lines than those familiar to us at present), stand for a type of half-civilized exploration such as the world (happily, perhaps) is never likely to see again. *O'Higgins* and *Cochrane* belong to a later age of men who have lived and died for the salvation of Chile, and their names and their exploits are still kept fresh and green in the minds and memories of the rising generation of patriots. The author does only fair justice to the general national patriotism of the Chilean people, who, recruited from nearly every country in Europe, or descendants of a mixed race of Spanish and Araucanian origin, are all at one in their heartfelt loyalty to the Chilean flag. It may be, as he

says, the beauty of the country, or the infinite variety of its climate, that exercises an irresistible charm over the settler, but it is a fact that the Scotsman who sings "Auld Lang Syne" with tears in his eyes does not want to go back to bonnie Scotland, nor does the German of Southern Chile yearn greatly for his Kaiser and fatherland. Chile is a comparatively young country. Undivided loyalty to the flag may yet prove the great safeguard of its national existence. There are not people enough, so far, to admit of much division of national sentiment. There may be too many lawyers, and there certainly is far too much of politics, but there is no room for a split in the camp of universal patriotism. The book, being chiefly historical, does not leave much room for the material progress of the country and the status of its army or its fleet, but what there is of both forms a useful summary of the present position, both commercially and strategically. The nitrate industry is well illustrated, and well-deserved attention is called to the extraordinary development of sheep-farming in the south. This led to a burst of speculation in 1905, after the boundary settlement with the Argentine was achieved, which is just now being balanced by an inevitable reaction. The best prospects of Chile's future, however, lie far more in the gradual clearance of the forest tracts adjoining the southernmost extension of the railway system, and the promotion of agriculture and colonization south of Valdivia (the Araucanian country), than in pastoral enterprise of the comparatively restricted grass lands of Tierra del Fuego or the Andine slopes east of the snow-line. The rising interests of commerce in the Pacific will also offer new openings to Chilean enterprise. Chile is a growing country. The pageantry of war and revolution has, we hope, passed from her for ever, and a new vista opens before her. There may yet be a federation of the Spanish-speaking states of South America, which appears to some politicians to be the one thing necessary to relieve the vague but ever-perceptible shadow which creeps slowly southwards from beyond the equator. The difficulty will be the flag. If that difficulty can be solved, there would appear to be nothing to prevent South America from competing with North America for the material wealth of the world. Mr. Scott Elliot's book is well worth attentive study. It is always a matter of interest to inquire into the processes by which great nationalities are formed, and it is just this which is so excellently well told and so well illustrated.

PERU.

'Peru in 1906.' With a brief historical and geographical sketch by Alexander Garland, member of the Lima Geographical Society. Lima, 1907.

This is a folio volume in English, of 303 pages, prepared by order of Dr. Don José Pardo, the accomplished and enlightened President of Peru. Mr. Garland's well-written historical and geographical chapters also include very full information respecting the educational system and the institutions of the capital. The fourth section contains chapters on the agriculture, mining, manufactures, trade, and means of communication, on the currency, banking, finances, and the press. It is quite a model for what such a report should be, and is well illustrated with portraits, views, and maps.

GENERAL.

FRANÇOIS COILLARD.

'Coillard of the Zambesi. The Lives of François and Christina Coillard, of the Paris Missionary Society, in South and Central Africa (1858-1904).' By C. W. Mackintosh. *Frontispiece, Map, and 77 Illustrations.* London: T. Fisher Unwin. 1907. Price 15s. net.

In the ranks of the great missionary pioneers in Africa, François Coillard occupies a position midway between that of Robert Moffat and David Livingstone.

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Unlike Moffat, his life-work was not confined to one region, and, unlike Livingstone, he never merged the missionary in the explorer. His direct contributions to geographical knowledge were not very extensive, neither is his biographer concerned to set them forth; Coillard's own book, 'Sur le Haut Zambèze' (English translation by the author of this biography, 'On the Threshold of Central Africa'), contains more information on that subject than the volume under review. Nevertheless, the life-story of a man who did much to give the map of South Central Africa its present political configuration cannot fail to appeal to other than purely missionary circles. Coillard was born in Asnières-les-Bourges, Berry, in 1834, of a French Protestant family, and went first to Africa in 1857 as a missionary of the Société des Missions de Paris. From that date until 1866 he was at work in Basutoland, and after an interval of two years, spent chiefly in Natal, he returned to Basutoland, where he continued his work of evangelization and civilization until 1877. In that year he led an expedition (promoted by Basuto Christians, who desired to start a mission on their own account) across the Limpopo through Banyailand, was taken captive to Lobengula's kraal, and by the Matabele sent to Bechuana-land. Thence, in 1878, he journeyed to the Zambezi, and in 1884 he founded the Barotseland mission. In Barotseland he spent the rest of his life, and there he died in May, 1904. In his forty-seven years' work he had but two furloughs in Europe, each lasting two years. In 1861 he was married at Capetown to Miss Christina Mackintosh, a lady of pure Highland blood, who, from that to the day of her death in 1891, shared all the joys and hardships of his journeys. Madame Coillard and a young niece who accompanied her were the first white women to see the Victoria Falls. In his Banyailand expedition, and in various journeys in the upper Zambezi valley, Coillard broke new ground, while his investigations into the manners and customs of the Basuto and Barotse tribes yielded rich material to the ethnologist. The great influence which he acquired with Lewanika and the Barotse in general was invariably used for the promotion of good government; it may be said without exaggeration that Barotseland as we know it to-day is the work of his hand. To his statesmanlike advice is due the fact that that country was added to the British Empire without the firing of a shot, and it is also largely due to his wise counsel that the Barotse have remained peaceful ever since.

Coillard throughout his life put his spiritual work first; the spread of Christianity was his absorbing passion, and it is rightly enough that side of his work which Miss Mackintosh emphasizes. Her narrative, brimful of excellent stories and pertinent comment on political questions, has at times a piquantly ironical strain. It is a fitting memoir of a noble, an heroic figure. A word in praise of the photographs should be added. They illuminate the text.

F. R. C.

SHORT NOTICES.

Europe.—"The Shaping of Lindsey by the Trent." By F. M. Burton. (London: Brown & Sons. 1907. Pp. xi., 59. *Diagrams and Illustrations*.) This study of a characteristic district of England traces its condition through various periods. The writer shows how it is possible to distinguish four different islands in succession—those of the chalk, the oolites and the Keuper, and the more recent isle of Axholme; and how the Trent, during the first two periods flowing in its old course, during which it carved the "gap" at Lincoln, but subsequently captured by the Humber, had the strongest influence on their formation and shape.

'The Bernese Oberland.' Vol. 3. By H. Dübi. (No. 11 of Conway and Coolidge's Climbers' Guides. London: Fisher Unwin. 1907. Pp. xxiv., 186.) This work, conveniently produced in the form of a note-book, with pencil and

sheets for memoranda, gives the necessary information as to club-huts, routes, etc., in connection with the sport to which it is a guide. But as it gives elevations in metres and feet of every elevation within the area treated, and careful references to authoritative maps, it would form a useful source for the close study of the region.

'A Book of the Cevennes.' By S. Baring Gould. (London: John Long. 1907. Pp. x., 308. *Map and Illustrations.*) This is a typically fascinating account of a few of the many points of interest in the curiously little-known country to the west of the Rhone. Clear description, geological and historical notes are welded into a readable whole by touches of personal narrative. There are many beautiful illustrations, though the map is a poor thing, and insists upon the Gulf of "Lyons."

'Climatotherapy and Balneotherapy.' By Sir Herman Weber and F. Parkes Weber. (London: Smith, Elder. 1907. Pp. 833.) Although this large volume deals with North African as well as European health resorts from the point of view of climate and mineral waters, it may be classified as European, as it is a third edition of 'The Spas and Mineral Waters of Europe,' considerably enlarged, under the editorship of Dr. F. Parkes Weber. Not only are there descriptions of a vast number of resorts, with the necessary details concerning each, but a treatise on climatology from the point of view of health, while a number of other general chapters, a bibliography, and other features attest the complete and authoritative character of the work.

'The Netherworld of Mendip.' By Ernest A. Baker and Herbert E. Balch. (Clifton: J. Baker. 1907. Pp. xii. and 172. *Plans and Illustrations.*) Speleology must be a study of peculiar fascination, combining as it does a true sport and a true science, and pervaded as its pursuit is by mystery. To all whom these attributes attract, this must be an entrancing volume, and it will become a classic in the study of British caves. For the attention of the authors is given, not only to the caves of Mendip, but, in a few of the later chapters, to caves in Derbyshire, Yorkshire, and Wales, and to the Mitchelstown caverns in Ireland. The narrative of their arduous journeys provides entertaining reading, and beyond this, the book gives evidence of the valuable new work they have done and are doing in a still almost virgin field of geography and geology.

'Ball's Alpine Guide, Part I. The Central Alps.' (London: Longmans. 1907. Pp. xxviii. and 327. *Maps.*) This guide, bearing the honoured name of John Ball, is of course a re-issue. The new edition has been "reconstructed and revised on behalf of the Alpine Club" under the editorship of Mr. A. V. Valentine-Richards, who has been assisted by a band of competent contributors selected from among the club's members. It appears to be all that a technical guide should be; of great value, not to mountaineers only, but to all intelligent visitors to the Alpine region. The maps, which bear the imprint of Ludwig Ravenstein of Frankfort-on-Main, are with one exception on the solid-colour contour principle, and are among the best German work on this system we have seen.

'Venice on Foot.' By Hugh A. Douglas. (London: Methuen. 1907. Pp. ix. and 422. *Maps and Illustrations.*) It is certainly not easy to walk in Venice without some guide, but this book should make it so, for directions are very carefully given. Very close details are given with regard to buildings—sometimes rather baldly, so that one is tempted to wish that the space occupied had been otherwise utilized, although it is true that by no other means could completeness be attained in so small a compass, for almost every house in Venice has its history.

'Cook's Handbook to Norway and Denmark, with Iceland and Spitzbergen.' (6th edition. London: Thomas Cook. 1907. Pp. 304. *Maps.*) Although this is a well-arranged and useful guide, it still, in its new issue, exhibits certain

minor inaccuracies, which, however, appear to be mainly printers' slips. On some of the outlying districts, and on Iceland, the information, from the tourist's point of view, reads as somewhat immature, but on the familiar parts it appears sound.

Asia.—‘Across Persia.’ By E. Crawshaw Williams. (London: Edward Arnold. 1907. Pp. xii. and 348. *Maps and Illustrations*.) This is a thoroughly entertaining travel-narrative, which leaves vivid impressions of the Persian and the scenery of his country on the mind of the reader. Mr. Williams travelled from Bushire by Shiraz, Isfahan, Kashan, and Tehran to the Caspian coast, so his book is rightly titled. It is also notable for perhaps the most astonishing index-entry ever conceived. “Author, the,” it begins, “arrives in Persia,” and continues with practically an analysis of the whole book in three columns.

‘Murray’s Handbook for Japan.’ (8th edition. London: John Murray. 1907. Pp. x. and 570. *Maps*.) This deservedly well-known guide has obviously been much improved in many respects. The introduction is admirably clear and concise. Special notice is merited by the maps, which bear the imprint of the Toyodo Engraving Office, Tokyo. Some of the detailed maps of small areas are beautiful work, and an interesting rainfall-map is included by permission of the Meteorological Observatory at Tokyo.

Africa.—‘Murray’s Handbook for Egypt and the Sudan.’ (11th edition. London: Stanford. 1907. Pp. xiv., [170], 613. *Maps*.) A great deal of work has been carried out in the new edition of this guide, under the editorship of Mr. H. R. Hall—not only of revision of existing material, but of recasting and rewriting. The spelling of names has been brought more nearly within the bounds of convention—a desirable reform to a book of this character. The maps also have received careful attention.

‘Two Dianas in Somaliland.’ By Agnes Herbert. (London: John Lane. 1908 [*sic*]. Pp. 306. *Illustrations*.) This account of a shooting expedition by two ladies possesses the interest attaching to an unusual proceeding, and those parts which deal with the chase are entertaining; the general narrative in which they are wrapped up is less attractive.

‘W. Holman Bentley, D.D.: The Life and Labours of a Congo Pioneer.’ By his widow, H. M. Bentley. (London: Religious Tract Society. 1907. Pp. xx. and 440. *Map and Illustrations*.) The career of the eminent missionary is well told, and nothing is more remarkable than to see laid down on the map the scope of his work and that of his colleagues.

General.—‘Peat: its Use and Manufacture.’ By Philip R. Björling and Frederick T. Gissing. (London: Griffin. 1907. Pp. xii., 173. *Illustrations*.) This well-arranged handbook treats peat from the scientific and every economical point of view. Details are furnished as to the methods of working it for various purposes. There is a very full bibliography. In the first chapter the geographical distribution of peat is briefly but clearly summarized.

‘Over-sea Britain.’ By E. F. Knight. (London: Murray. 1907. Pp. ix. and 324. *Maps*.) We have here a fair general text-book—“a descriptive record of the geography, the historical, ethnological, and political development, and the economic resources of the Empire”—dealing with the British possessions in the Mediterranean, Africa, and America. A second volume is intended to cover the rest of the ground. Such works are by no means so numerous as to make another unwelcome. The topographical maps are, unfortunately, poor; ignoring relief, they fail to illustrate one of the most important features of the text. The latter is systematically arranged, and apparently well indexed.

THE MONTHLY RECORD.

EUROPE.

Colonization of Newly-formed Land by Plants.—This is a subject which is being studied in various quarters at the present day, and the results are likely to be of great interest from the point of view of plant geography. An unusual opportunity for such a study has been supplied by Lake Hielmar, in southern Sweden, the level of which has, since 1882, been lowered by over 6 feet, with the result that not only have considerable areas been laid bare round its shores, but a large number of new islands have risen above its surface. The new growth of vegetation on these was examined by botanists in 1886 and 1892, and has lately been carefully studied on the spot by Mr. Selim Birger, who has been able to bring out some interesting points by comparing his results with those of his predecessors. His observations were published at length in the *Archiv für Botanik* for 1905, but have since been made more generally available by a short summary given in *Engler's Botanischen Jahrbuchern* (vol. 33, Heft 3). Altogether twenty-nine islands have been formed, some at a considerable distance from any old land, but only sixteen attain any great size, though twenty reach a height above the water of $2\frac{1}{2}$ feet and upwards. The observations are mainly concerned with phanerogams and vascular cryptogams, but the occurrence of some mosses and lichens was also noted. The progressive colonization of the islands is shown by the number of species recorded by the three different observers. Thus in 1886 (four years from the first lowering of the level), 113 vascular plants were noted; in 1892, 184; and in 1904, 202; and this in spite of the eventual disappearance of some of the earlier arrivals. It is an interesting fact that in the case of islands which have merely received an extension of area, the newly-formed portions seem to have supplied access for new species, even to the older portions. Mr. Birger distinguishes between casual and constant or regular modes of dispersal, and shows that the latter is far the more important, as is proved by the wide diffusion over the islands of individual species. Of the factors of dispersal, the water is by far the most effective. At times of high water, seeds or portions of plants are carried to portions of the islands which are dry at other times, and on the retreat of the water are retained by the existing vegetation as by a sieve. Parallel lines of such debris are often formed, and on one of the islands the writer found thirteen specimens of *Picea excelsa* (Norway spruce) growing in a line on a bank so formed. The prevailing wind being from west to east, the current sets in the same direction, and the new arrivals establish themselves first on the west side of the islands. The part played by the wind directly is of secondary importance, for on the newly formed islands there is nothing to retain objects brought by this means. Birds and man are both instrumental in introducing plants, the former in part through the material used for their nests. The height of the islands above the water is important in determining the rapidity of the process of settlement, some of the higher islands having gained over seventy species in twenty-two years. After ten years plant formations already show signs of development, a series of zones succeeding each other from the shore to the centre of the islands. Young forest is already growing up towards the middle of the islands, the most common species being *Betula verrucosa*, *Populus tremula*, *Alnus glutinosa*, and *Salix caprea*, though fourteen different species in all are represented, including *Pinus sylvestris* and *Picea excelsa*. The trees, some of which have already reached a considerable height, show signs of spreading at the expense of the other formations, which is a reason of the dying out of certain species which had obtained a footing.

Changes on the Baltic Coast of Schleswig.—A careful study of the recent losses and gains on the east coast of Schleswig, especially during the period between 1795 and 1875, has been made by Dr. G. Wegemann, who summarizes the results in *Petermanns Mittheilungen*, Nos. 9 and 10, 1907, giving also a map on which the position and extent of the losses and gains are clearly laid down. The reason for not bringing down the comparison later than 1875 is that this was the date of the last cadastral survey of this region, and that no trustworthy observations of more recent changes are available. The basis of comparison at the earlier date is supplied by the cadastral survey of northern Schleswig carried out between 1788 and 1800, records of which are for the most part preserved. The accuracy of this earlier survey varies greatly in different parts of the area, and it is only in the case of Kjelstrup and Wilstrup that modern requirements can be said to have been fulfilled. It is, therefore, unsafe to trust to the accuracy of the results obtained by a comparison of the areas given by the two surveys without closer inspection, but Dr. Wegemann thinks that where the error of the old survey does not exceed about 0.5 per cent., we may admit differences of area of 100 square miles and over in the case of units which do not exceed 1 hectare, though for larger units the difference obtained by comparison of the two surveys must be proportionately greater to be accepted as trustworthy. Dr. Wegemann says that current ideas as to the conditions and causes of changes on the German coasts are in many ways erroneous. Thus it is a mistake to suppose that the land normally gains in area, and that loss is confined to exceptional periods of storm. It is necessary to take into consideration the differences in geological structure and geographical position between different parts of the same coast, for these play an important part in determining whether the coast-line is advancing or receding. Portions which are favourably placed on the whole may suffer from an exceptional storm, but rarely show a continual loss. The high portions of the coast (known locally as *klint*) are worn away both by atmospheric agencies and by the direct action of the waves, the latter coming into play almost exclusively during storms, and being most effectual where there is a wide sea-area in which to develop their force. While the exposed headlands are thus eaten away, the bays and inlets are filled up by the eroded material. Dr. Wegemann treats in detail of the coasts in question, describing the geological structure of the separate portions, and tracing the amount of loss and gain in each special case. His map brings out clearly the influence of exposure to waves, currents, etc., in determining the portions specially subject to loss, though it is not quite evident whether the currents shown by means of arrows actually exist, or are merely such as would give rise to the observed conditions.

ASIA.

Climbing in Sikkim.—The Indian newspapers contain an account of an attack on Kabru (24,015 feet) made on October 20 last by two Norwegian climbers, Messrs. Rubenson and Monrad-Aas, in which the summit ridge between the two peaks was reached at a point about 23,900 feet. The mountain was approached from the south-west by the Rathong valley and glacier. Snow and ice were met at 18,000 feet. At 19,500 feet a camp was formed under "the Dome" of Freshfield's map. At this point an ice-fall was encountered which was only rendered passable for coolies after five days of hard work with ice-axes. A camp was formed 21,500 feet above sea-level, on the upper snow-slopes visible from Darjiling under the crest of Kabru; but this not proving high enough, a tent was moved up to 22,000 feet, where with two coolies the travellers passed the night; temperature - 29° Centigrade. Leaving the coolies in camp, the Norwegians started at 8.30 a.m. An icy wind impeded their progress and forced them towards the lower or north-east peak. The

climbing was fairly arduous, steps having frequently to be cut, so that it was not till 6 p.m. that they reached what had appeared to be the summit. They found a snow-ridge some 60 feet higher beyond, to which they had not time to go on. Descending in the dark, one of the party slipped, but was held by his companion, and they regained camp in safety by moonlight. Mr. Monrad-Aas was somewhat severely frostbitten. Neither of the climbers suffered seriously from mountain sickness. They speak in warm terms of the behaviour of their coolies, in whose management they seem to have been exceptionally successful. We hope at a future date to give full details of this interesting exploit. The climbers' route can be followed in detail on Signor Sella's photographs. It does not coincide, except perhaps in the last climb, with that described by Mr. W. W. Graham, who approached the mountain from Alukthang, at its south-east base.

Heights of Himalayan Peaks.—It is generally recognized that the heights obtained by the Trigonometrical Survey for the culminating summits of the Himalayas, by observations from distant stations, cannot be trusted to be minutely accurate by reason of the varying effects of refraction which came into play. The extent to which uncertainty may be due to this cause when only long-distance rays are available is shown by Colonel Burrard in the *Annual Report of the Board of Scientific Advice for India* for 1905-06 (Calcutta, 1907), in the section dealing with geodesy. As is well known, the coefficient of refraction to be used in correcting the observed heights differs according to the altitude of the point of observation, but we are still ignorant of the exact scale of such variation. In calculating the height of Kinchinjunga, Sir Andrew Vaugh used a coefficient of 0.077, while in the case of K_2 , Colonel Montgomery used one of 0.047, the observations in the former case having been taken from the plains of India, whereas in the latter they were taken from altitudes of 15,000 and 17,000 feet. But though there is no doubt that the coefficient used should be smaller for K_2 than for Kinchinjunga, we cannot yet say whether the above difference was or was not too great. If the coefficient were the same in the two cases (whatever its amount), Kinchinjunga would be the higher of the two peaks, so that it cannot be said with certainty that K_2 is the higher, as is indicated by the figures adopted by the Survey. Again, the height of Mount Everest, as given by the mean of six observations from the plains, is 29,002 feet (the range of variation in the individual results being only 36 feet). But when observed from the Darjiling hills, the mean, as deduced from six observations, becomes 29,141 feet, the coefficient of refraction being assumed as 0.05, instead of 0.07, as in the former case. Here again the range of variation is very small—only 17 feet. Colonel Burrard uses an ingenious method of testing the relative suitability of the possible coefficients of refraction in the case of certain peaks. Thus for Nanga Parbat he has calculated the range of variation in the values obtained from eleven different stations, according as the coefficient employed varies from 0.04 to 0.10, and finds that such range is smallest (125 feet) for the value 0.05, while for the value 0.10 it amounts to as much as 1028 feet. The mean obtained for the height of Nanga Parbat, with the coefficient 0.05, is 26,676 feet, or very near that adopted by Montgomery (26,620 feet), which results from the adoption of a general coefficient of 0.057. By a similar method Colonel Burrard finds that the accepted height of Dhaulagiri (26,795 feet) is probably too low. This method must not, of course, be trusted too far, as we are not justified in assuming the same coefficient to be applicable to each observing station. It is proposed to persevere with the observations, as better results may be expected from a long-continued series.

Kozloff's New Expedition.—Our Hon. Corresponding Member, Colonel J. de Shokalsky, sends us some details regarding the new expedition to Central Asia organized by the Imperial Russian Geographical Society, which was just starting

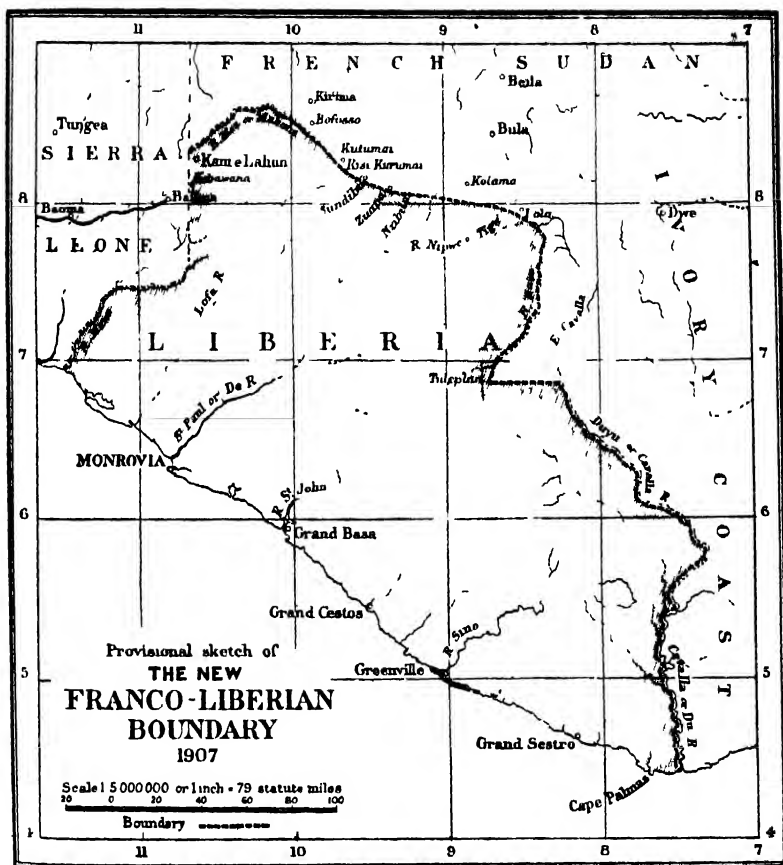
when he wrote. It is, like the last, under the command of the experienced traveller Colonel P. Kozloff, well known for the part which he took in the expeditions of Prjevalsky, Petzoff, and Roborovsky, and for his own great journey in Eastern Tibet as commander of the last expedition sent by the society. The new expedition has as its object the exploration of Southern Mongolia, the district of Kuku-nor and western slopes of Nan-Shan. Kiakhta is chosen as the starting-point. Thence the expedition will travel to Urga and to Din-yuan-in, crossing the Gobi by a route somewhat to the east of that of the last expedition in 1899-1901, and making some small digressions in order to explore the chain of Bet-khara-narin-ula. At Din-yuan-in the base of the expedition will be established, and a regular meteorological station arranged for a year. From this point a journey will be made to the Gon-ju, the land of Badang-Jareng, and thence southward through the Nan-Shan chain to lake Kuku-nor. Other journeys will be undertaken from the base in the direction of the Alashan range and Ordos. The great basin of Kuku-nor will be explored as completely as possible, and for this purpose the expedition is supplied with thermometers, sounding-machines, and other instruments. It also possesses a small boat. From Kuku-nor the expedition will proceed by way of Lan-chou-fu to Din-yuan-in, and thence north in the direction of the Russian frontier. It will probably occupy one and a half or two years. A young geologist of the University of Moscow is attached to the expedition, which consists in all of some twelve or fourteen members.

AFRICA.

The Volcano of Alid, Eritrea.—As in other parts of East Africa, the great trench or rift-valley which skirts the eastern edge of the Abyssinian plateau is marked by the evidences of volcanic activity, some of it persisting to the present day. Almost at the northern extremity of the zone of depression occurs the volcano of Alid, which, though known of vaguely for some years, has only lately been examined with any care by the Italians. An ascent of the volcano was made early in 1906 by Profs. Dainelli and Marinelli, who describe its physical features and relations with the surrounding country (which shows other traces of volcanic action) in the *Rivista Geografica Italiana*, June and July, 1907. The mountain, which reaches an altitude of 910 metres (2985 feet), and blocks a great part of the trough from which it rises, lacks the conical characteristic of volcanoes, its principal crest forming an elongated ring, within which a well-marked furrow runs from south-west to north-east, or at right angles to the direction of the trough. Within this ring, towards the western end of the enclosed space, is a great crater, over half a mile in diameter, with walls of some 350 feet in height. The Italian official map is incorrect in marking a second crater further east. Fumaroles occur both inside the crater and elsewhere on the mountain, but the vapours which escape are almost entirely wanting in the chlorine compounds which are so abundant in the case of the Italian volcanoes. The outer slopes descend somewhat abruptly to the base, which is of small relative extent, this peculiarity in the contour being, perhaps, due to the small amount of precipitation in this region. To the north and to the south a vast lava-plain extends, and from its surface a large number of small cones and craterlets rise, which seem to be arranged more or less in lines, but have no apparent relation to the main volcano. The writers think that they are the outcome of a later period of volcanic activity, and that the lava which forms the plain has been derived from these vents rather than from the main volcano. They were not able to study the geological structure of the latter with any minuteness, but think that its base is in part composed of crystalline rocks, though trachitic and basaltic materials seem to form a larger part of it.

In the November number of the same journal Captain Tancredi reports an eruption, in June, 1907, of the peak of Afdera, on the Abyssinian side of the frontier in about $13^{\circ} 15' N$.

The New Franco-Liberian Frontier, negotiated between the President of Liberia (on his recent visit to Europe) and the French Government, will run as follows: "Starting from the point on the frontier of the British colony of Sierra Leone where the river Moa or Makona crosses that frontier, the Franco-Liberian frontier shall follow the left bank of the river Makona up-stream to a point 5 kilo-



metres to the south of the town of Bofosso. From this point the frontier shall leave the line of the Makona and be carried in a south-easterly direction to the source of the most north-westerly affluent of the Nuon river or Western Cavalla. This line shall be so drawn as to leave on the French side of the boundary the following towns: Kutumai, Kisi Kurumai, Sundibú, Zuapa, Nzibila, Kolama, Bangwedú, and Lola. From the north-westernmost source of the Nuon, the boundary shall follow the right bank of the said Nuon river down-stream to its presumed confluence with

the Cavalla, and thenceforward the right bank of the river Cavalla down to the sea. If the ultimate destination of the Nuon is not the Cavalla river, then the boundary shall follow the right bank of the Nuon down-stream as far as the town of Tuleplan. A line shall then be drawn from the southern outskirts of the town of Tuleplan due east to the Cavalla river, and thence shall follow the right bank of the Cavalla river to the sea." It has been generally assumed that the Nuon flows into the Cavalla, and in any case, it flows in the lower part of its course very near to the north-westernmost bend of that river; but it is now believed to be the upper St. John's river (see below). Tuleplan is in about lat. $6^{\circ} 50'$. The river Makona takes a much more northerly course than has hitherto been estimated. The river Nuon is also situated 20 or 30 miles further to the east than it is put on English maps, and the Cavalla also takes a more eastern course. Consequently, the territory of Liberia as thus demarcated is rather larger than it would appear on the uncorrected English maps at the present date, many of the recent French surveys not having been published. The accompanying sketch-map shows provisionally the course of the frontier, which cannot be laid down exactly until surveyed on the spot. The Franco-Liberian Delimitation Commission is starting work very shortly (during the coming dry season). The principal Liberian representative will be a distinguished Dutch surveyor and explorer, who will be assisted by an officer of the Dutch navy. He will probably be accompanied by one or two Liberian colleagues already trained to geographical work. It may be mentioned, in this connection, that the correct spelling of the name of the river which bounds Liberia on the east is *Cavalla*, not *Cavally*. This last form has only recently come into use by an American corruption of the older form. *Cavalla* was a name applied to the river by the Portuguese in 1480 (approximately), and it means "Horse mackerel." This fish swarms in certain seasons at the Cavalla bar.

Surveys in Liberia.—With reference to the question of the Liberian frontier above referred to, we have been informed that the recent surveys of Messrs. Parkinson and Owen and of Messrs. Byrde and Leighton, in the service of the Liberian Development Chartered Company, have considerably altered the inner geography of that land. (Mr. S. Owen was trained under Mr. Reeves of the Royal Geographical Society before going to Liberia.) According to Messrs. Parkinson and Owen, the main stream of the St. Paul's river comes much more from the east than was supposed. According to Mr. Byrde, the Nuon river is really the upper St. John's, which enters the sea at Grand Bisa; while according to Mr. Leighton, the upper Cavalla does not take such a considerable bend to the west as had been conjectured by the French explorers.

The Nigeria-Kamerun Boundary.—The delimitation of the southern section of this boundary, from Yola to the Cross river, one of the last West African boundaries to be taken in hand, is now being carried out by a mixed commission under Major Whitlock (on the British side) and Captain Häring (representing Germany). The commissioners met at Nassarawa in September, 1907, and work was at once commenced. As the work of delimitation on the northern frontier of Nigeria has also been in progress for some time, the whole of the boundaries of the territory will soon be definitely fixed.

Captain Lenfant's Expedition to the Southern Shari Basin.—Further particulars of the work accomplished by this expedition (*Journal*, vol. 30, p. 440) are given in the November number of *La Géographie*, accompanied by a sketch-map showing the network of routes traversed by the various sections of the expedition. The area covered by them extends from Forth Archambault on the Shari, in the north-east, to Carnot on the south-west, between which extreme points a belt of country varying from 100 to 200 miles in width has been examined with

unusual thoroughness. All the main outlines of the hydrography have been brought to light, and the importance, in the Shari system, of the Wam, or Wom, has been fully established. It forms the upper course of the Bahr Sara, as was virtually proved some years ago by the expedition of M. Bernard (*Journal*, vol. 17, p. 306). This traveller suggested that the Bahr Sara (the existence of which M. Maistre was the first to bring to light), might be considered the main headstream of the Shari, and this is borne out by the measurements at the confluence carried out by members of Captain Lenfant's expedition, which showed that the volume of the Bahr Sara was, at the time of measurement, more than twice that of the eastern headstream. The Wain-Bahr Sara is now known from its source to its mouth, and its main tributaries have also been mapped. Whilst its lower course, to a little above the confluence of the Fafa (right bank) is navigable, the upper course is so obstructed by rapids as to be quite impracticable. The discovery of the Pende, one of the two principal headstreams of the Logone (the other being the Mambere), has already been recorded in the *Journal*, as well as the opinion of Captain Lenfant that it will supply the best route from Carnot to Lake Chad. During the prosecution of the work of the expedition, one of the parties met with some difficulties through the hostility of the Mbakas, a race of cannibals, who kept up their attacks for a week, but otherwise peace seems to have been maintained with the natives.

Nyasaland.—By an Order in Council of July 6 last, published in the *London Gazette* for September 3, the British territory hitherto known as the British Central Africa Protectorate will in future be styled the Nyasaland Protectorate. The title of the Commissioner is also changed to that of Governor, whilst executive and legislative councils are established. Sir Alfred Sharpe has been appointed the first governor.

AMERICA.

Mining in British Columbia.—From the official report of the mining operations in British Columbia for the year ending December 31, 1906, it appears that the total production for that year amounted to the value of \$24,930,546, 11·2 per cent. over that of 1905, 31·6 per cent. over that of 1904, and 42·8 per cent. over that of 1903. To the total production of 1906, copper contributed \$8,288,565; gold (placer and lode) \$5,579,039; coal, \$4,551,909. British Columbia's production of copper in 1906 far exceeded that of all the rest of the Dominion, which amounted to but \$2,318,095. Much more still did its gold production exceed that of all the rest of the Dominion, except Yukon territory, which slightly exceeds it. Its lead production, again, amounted to nearly twenty-four times that of the rest of the Dominion. Its coal production for 1906—nearly two-seventh of that of the Dominion—is the highest on record for any year, exceeding that of 1905 by the value of \$398,973. The total mining production for all years up to and including 1906 amounts to \$273,643,722, gold standing first, and coal and coke second. The collieries of British Columbia are at present, and expect to continue for some time to come, pressed by more orders than they can answer, a stringency attributed chiefly to scarcity of labour. The only coalfields actually producing coal are the Vancouver island coalfield, on the east coast of Vancouver island, and the Crow's Nest pass coalfield in the extreme south-east of the province, on the west slope of the main range of the Rocky mountains. The gross amount of coal mined in the Province in 1906 was 1,899,076 tons, or 73,244 tons more than that of 1905. Some 381,773 tons of this coal were manufactured into coke, of which there were produced 199,227 tons. Of this output of coal and coke, 681,889 tons of coal were sold for consumption in Canada, and 679,829 tons for export to the United States. Though

not yet producing coal in the commercial sense, properties in the Nicola valley are being opened up systematically since the completion of the railway from Spence's Bridge to the Nicola coalfield. A seam of coal 6 to 8 feet thick has been opened up by the Nicola Valley Coal and Coke Co., and it is expected that the property will be shipping coal in 1907. The Pacific Coal Co. at Hosmer, on the Pacific railway, has also begun active operations. The Report, including special district reports, is illustrated by diagrams, plans, and plates, a map of Columbia, and a geological map of Graham island.

The International Boundary West of Lake Superior.—In a communication to *Science* for July 19 last, Mr. H. N. Winchell calls attention to some early maps of the region between Lake Superior and the Lake of the Woods, as showing that the international boundary as finally drawn in 1842 gave to Canada a considerable area (some 2500 square miles), which would have formed part of the United States had the intentions of the negotiators of the original treaty of 1783 been adhered to. As is well known, the eventual and existing boundary follows an arbitrary and unnatural direction in crossing the Lake of the Woods, in order to pass through what was accepted in 1842 as the north-west angle of the lake, and it is commonly held, in this country at least, that Canada was the loser to a small extent by this deviation of the frontier from a common-sense line. But Mr. Winchell points out that there were two or more distinct water-routes from Lake Superior to the Lake of the Woods, and he holds that the intention in 1782-3 was that the most northerly of these should be followed, and that the line should be carried, not to the point eventually agreed upon as the north-west angle of the Lake of the Woods, but farther north, to its outlet at Rat portage, as shown in an English map published by Laurie and Whittle in 1794. The acceptance of the more southerly line he attributes to the inadvertence of the American Commissioners in 1842. It may be remarked, however, that, whatever was the intention of the treaty of 1783, there was an obvious fairness in carrying the line farther south, inasmuch as the outlet of the Lake of the Woods was supposed at the time to lie farther south than subsequently proved to be the case. And it is by no means certain that Mr. Winchell's contention is correct, for it is not borne out by the map in Kitchen's atlas, which laid down the boundary-line in the very year of the original treaty.

The Discovery of San Francisco Bay is the subject of a careful monograph (San Francisco, 1907) by Dr. George Davidson. Ransacking all available sources, the monograph brings to bear on the documentary evidence, obscured in many parts through alteration of local nomenclature, inadequate description, and inaccurate determinations of latitude, the searchlight of familiarity with the coast-line traversed—its every cliff, islet, rock, and headland, its forest, timber patches, and old Indian trails—a familiarity acquired by forty-five years' geodetic and geographical work on the seaboard. The monograph includes a history of Spain's heroic efforts to reconnoitre the coast from Cape San Lucas northwards, and comprises passages, not only of geographical, but also of human interest. The following are events in the earlier history of the north-western seaboard exploration: Cortes delineated the east and west shores of the Mare Californiæ, but by 1536 the exploration of the Pacific had reached no higher than Cape San Lucas. In 1539 Ulloa reached Cabo del Engano, in 29° 56' N. On September 28, 1542, an expedition under Cabrillo discovered San Miguel, now San Diego, bay. Driven off Point Conception, the expedition anchored on the north shore of San Miguel, the westernmost of the Santa Barbara islands, at a port called by them Port Possession. On November 14 they sighted the mountain massif (2200 feet) overhanging Fort Ross (38° 31' N.), but advanced no farther. This landfall, 75 miles north-west

of the Golden Gate, they named El Cabo de Pinos. Probably they also saw King Peake, in $40^{\circ} 9'$. On their retreat they discovered (November 16) the gulf of the Farallones, just missing the Golden Gate. This gulf, measuring 1200 square miles, they called "Bahia de los Pinos." Cabrillo and Ferrer, his pilot, were thus the first Europeans to see the hills of San Francisco and the islands of the two groups of the Farallones. Making another attempt northwards, in 1643, the vessels reached Fort Ross, and probably saw as far north as Point Arena, in $38^{\circ} 57'$. On January 17, 1579, Drake sheltered in Drake's bay, east of Point Reyes, taking possession of the country, which he named New Albion. Under the stimulus of Drake's and Cavendish's exploits, Carmeño, commanding the galleon *San Augustin*, made (end of 1595) the latitude of Point Reyes, but, driven ashore, the vessel was totally wrecked. Next, Vizcaino reported the discovery (December 16, 1602), of a port in 37° N., to which he had given the name Monterey. Vizcaino's thirty-two reconnaissance-sketches, hidden for two hundred years, were exhumed in 1802. They give no sign of the Golden Gate. Bolinas point, however, is named after Vizcaino's pilot. Then, after Spanish exploration had been suspended for 165 years, the Portola land expedition of 1769, not finding Vizcaino's "famous port" in 37° , discovered the south-eastern part of the Bay of San Francisco, but not the Golden Gate, which was first sighted by the Pages Expedition of 1772. Prof. Davidson traces the early stages of settlement on the site of San Francisco.

AUSTRALASIA AND PACIFIC ISLANDS.

The Highest Summit of Tasmania.—The highest point in the Ben Lomond range, in north-eastern Tasmania, has hitherto been supposed to be a station of the Trigonometrical Survey at the southern end of the range, the height of which was fixed by the Survey as 5010 feet. It is possible, however, that a point near the northern end, not fixed by the survey, may be still higher; and some provisional observations with a view to settle the point have been made, at the instance of Colonel Legge, by Messrs. Giblin and Piesse, who submitted the results to a meeting of the Royal Society of Tasmania on June 11, 1907. The observations, made in 1906 and 1907, are not such as to give a final result, being made by aneroid, controlled by a rough measurement with an Abney level. But as the observations were several times repeated, care being taken on each occasion to use the mean of ascending and descending readings of the aneroid, and to make allowance for the barometrical conditions at the same time, the probability seems to be that the result is fairly accurate, especially as the observation with the Abney level confirmed the determination by the aneroid, the height given in each case lying between 5100 and 5200 feet. The northern summit of the range (for which the name Legge's Tor is proposed by the authors of the paper) may thus be the culminating summit of Tasmania, Cradle mountain, the height of which is stated on the maps to be 5069 feet, being in this case the second highest. Messrs. Giblin and Piesse hope to settle the point by triangulation during the present year.

GENERAL.

Geographical Boundaries.—A thoughtful and suggestive paper under this title, contributed by Miss E. C. Semple to the *Bulletin of the American Geographical Society* for July and August last, forms an interesting complement to Lord Ourzon's lecture on frontiers, referred to in the December number of the *Journal*. While the latter was largely concerned with modern political frontiers and the more or less artificial conditions governing them, Miss Semple applied herself rather to the natural laws which determine the evolution of boundaries in the earlier stages of

human society. The paper forms but a chapter of a more elaborate work on the 'Influences of Geographic Environment,' the appearance of which the author's special competence to deal with such a subject leads us to anticipate with much interest. The key-note of the present chapter is the zone-like, fluctuating character of natural boundaries as opposed to the hard-and-fast lines which may eventually be developed from them or arbitrarily laid down by political agreements. This same character is to be traced in geographical boundaries of all kinds, whether marking the distribution of natural phenomena—such as forest or prairie, perpetual snow, and the like—or concerned with the mutual relations of mankind. "The habitable area of the Earth everywhere shows its boundaries to be peripheral zones of varying width, now occupied and now deserted, protruding or receding according to external conditions of climate and soil, and subject to seasonal change." The boundaries of race and state which are subject to greatest fluctuations are those which are determined by the resistance of other peoples, anything which increases the expanding force of the one being registered in an advance of its boundary and a retrusion of that of its neighbour. The more aggressive people throws out long streamers across the debatable zone, and its advance is helped on by the formation of ethnic islands beyond the base line of continuous settlement. Narrow straight boundaries point to an equilibrium of forces, and are found in old, thickly populated countries, while the wide, ragged border zone belongs to new and especially to colonial peoples, being most irregular where a superior intrudes upon an inferior people. The tendency to excessive expansion by following lines of least resistance is especially characteristic of primitive and nascent peoples, and natural boundaries which set bounds to this expansion, such as mountain, sea, or desert, are of far greater importance for such peoples than for more fully developed ones. All natural features which serve to check or retard expansion tend to become racial or political boundaries, and all present a zone-like character, a frontier wilderness being again and again found to separate neighbouring peoples, sometimes as a result of formal agreement. Such border wastes are sometimes, however, occupied by alien races, whether too insignificant to arouse the desire of conquest, or powerful enough to take advantage of the favourable conditions of life sometimes offered. Even when the nicely determined political boundary has been evolved out of the wide waste zone, it is still encased in a zone of contact wherein are mingled the elements (especially the ethnic ones) of either side; and such a border zone of assimilation has a particular significance as preparing the way for the advance of the state boundary from either side. The influence of a border situation in various other directions (such, *e.g.*, as in that of favouring political autonomy) is also traced, and a wealth of illustration supplied from actual instances, for which, however, reference must be made to the original article.

An Undescribed Map of Visconte Maggiolo.—Among the many little known maps that have been brought to light of late years, especially in the Italian libraries, is one of Visconte Maggiolo now in the Biblioteca Federiciana at Fano, to which it was presented by its former owner, Cav. Luigi Masetti, in 1862, but which had not become generally known to students until the present year. It has now been described in the November number of the *Bolletino* of the Italian Geographical Society by Prof. S. Crinò, a well-known student of the history of cartography. The map embraces the whole of the world as known in the early part of the sixteenth century, and bears the legend: "Ego Vesconte de Majollo compoxui anc cartam de anno dni 154 (*sic*), de viii. juni in civitatem Janua." It is drawn on parchment, and measures $4\frac{1}{2}$ feet in length, the scale working out as just 1 : 20,000,000. Prof. Crinò says that the map shows a good knowledge of the results of the new discoveries, and he specially praises the portrayal of Africa and the new

world, though he is hardly happy in his reference to the delineation of the Nile and the mountains of the Moon (evidently after the Ptolemaic model) as an instance of the up-to-date character of the map. As a rule, the coasts and islands are represented, but not the mountains or rivers (except the Nile), while perspective views of the cities and ports are given, with the flags of the various nations, as well as the Pope's line of demarcation between the spheres of Spain and Portugal. The place-names are written in various directions, but the most important are all to be read with the south at the top of the map, as was often the case at the time. In the centre, there is a small circular inset, giving a general representation of the world, which is reproduced by Prof. Crinò. Owing to the obvious omission of a cypher from the date, this cannot be determined with certainty, but if, as Prof. Crinò plausibly suggests, the map is that known to have been made in 1534 for the historian Lorenzo Lomellino, the missing figure can be restored. The probability is strengthened by the fact that no other known map by Maggiolo shows in a single sheet the whole known world, as was to be the case in that made for Lomellino.

A Cartographical Monthly.—We are pleased to learn that the firm of Justus Perthes of Gotha have decided to commence the issue of a new monthly publication, intended to supply information on new publications in the field of cartography throughout the world. It will form a supplement to *Petermanns Mitteilungen* under the title *Kartographischen Monatsbericht*, and will be edited by Dr. H. Haack, whose previous services in a somewhat similar field, both as editor of the *Geographen-Kalendar* and as a collaborator in the *Geographisches Jahrbuch*, are substantial proofs of his competence for the work. It is intended to give the new publication the widest possible scope, by reporting exhaustively, not only on new maps (whether issued by governments or private firms), but on all publications dealing with cartography in its widest sense. The new venture, which should prove of the greatest value to all geographers, will realize one of the most important objects of the proposed "International Cartographical Association," the desirability of which has been repeatedly urged, especially by the late General von Tillo, at the meetings of the International Geographical Congress, though little progress has been made towards the practical realization of the idea.

OBITUARY.

Sir James Hector, K.C.M.G., F.R.S.

THE late Sir James Hector, formerly Director of the Geological Survey of New Zealand and a Gold Medallist of this Society, whose death occurred at Petone, near Wellington, on November 6 last, belonged to a school of scientific students which the expansion of knowledge and the growth of specialization are fast tending to destroy. Though first and foremost a geologist, he was essentially an all-round student who took the whole realm of natural science as the field of his inquiry. His earliest associations were with the law. He was born at Edinburgh on March 16, 1834, the son of a Writer to the Signet, whose skill in reading ancient black-letter manuscripts of Scottish legend and history had often been exercised for the benefit of Sir Walter Scott. He himself, leaving school at a comparatively early age, served for a time in his father's office, and then was articled to a leading actuary

in the city. His bent for scientific study had, however, already begun to show itself, and was cultivated by attendance at the university classes. Here his industry and talents speedily brought him to the front, and finally he entered the university school of medicine, and, passing through, took his full M.D. degree at the early age of twenty-two.

A brief period, during which he acted as assistant to Sir James Simpson, was terminated by an offer which he received from Sir Roderick Murchison, acting on the recommendation of the university authorities, of a post as surgeon and geologist to the Government expedition under Captain John Palliser for the exploration of Western Canada. In this expedition, the despatch of which, in 1857, was largely due to the representations of the Royal Geographical Society, of which Sir Roderick Murchison was then President, young Dr. James Hector greatly distinguished himself. He took a leading part in the scientific work of the expedition, and carried out extensive explorations among the Canadian Rockies, discovering five passes, of which one, the Kicking Horse pass, is that by which the Canadian Pacific Railway now crosses the range. He traversed the auriferous valleys of British Columbia, visited the high-grade bituminous coal-area along the eastern shores of Vancouver island, and afterwards passed south through the mining regions of California and Northern Mexico before returning home by way of Panama and the West Indies.

Almost immediately after his return and the preparation of his reports on the scientific work of the expedition, Dr. Hector was offered the choice of geological appointments for which Sir Roderick Murchison had been asked to recommend candidates, one in Kashmir, and the other as geologist to the Provincial Government of Otago. He accepted the latter, and went out to New Zealand in 1861, about the time of the discovery of the Otago goldfields. During the next three years he was busily engaged in the exploration of the province, and did particularly good work in opening up practicable routes through the mountains between the east and west coasts of South island. In 1864 an account was read before the Society of one of his expeditions to the west coast of Otago, resulting in the discovery of a low pass from Martin's bay to Lake Wakatipu. What, however, first brought Dr. Hector prominently to public notice in New Zealand was his work as Government Commissioner for the Dunedin Exhibition of 1865, for the purposes of which he made a general tour through the colony. The gifts of organization he then displayed were afterwards utilized on several occasions, when he was called on to act as New Zealand Commissioner at exhibitions in Philadelphia (1876), Sydney (1879), Melbourne (1880 and 1888), and at the great Indian and Colonial Exhibition in this country in 1886.

Early in 1865 Dr. Hector was appointed Director of the Geological Survey of New Zealand, a post he held for just forty years. In this capacity, and as curator of the New Zealand museums, he did admirable work in placing knowledge of the structure and mineral wealth of the Dominion on a sound scientific basis. In addition to the annual reports of the Survey, numerous papers embody the results of his geological researches. In particular, he drew up, in 1866, the first general report on the coal-deposits of New Zealand, and of a more general character may be mentioned his 'Handbook of New Zealand.' He also took a keen interest in the collection of meteorological data, and was actively associated with the organization of the Botanical Gardens at Wellington. But perhaps in nothing was the wide range of his scientific sympathies and activities more prominently displayed than in connection with the New Zealand Institute, which, dating from 1868, embraces philosophical societies in various centres in the Dominion. Of this he acted from the commencement as manager, and edited with marked ability the voluminous *Transactions* of the Institute. In 1885 he was elected Chancellor of the New

Zealand University, and continued in office as Chancellor or Vice-Chancellor till 1903.

Many honours were showered on Sir James Hector in recognition of his scientific attainments and varied services to the empire. He was a member of numerous learned societies in Europe, America, and Australasia. Of this Society he was a Fellow from 1861 to 1890, and in 1891 was awarded the Founder's Medal "for the services rendered by him to geography by his papers on British North America and New Zealand." In 1866 he was elected a Fellow of the Royal Society, and in 1875 was awarded the Lyell Medal of the Geological Society. In 1874 he received the Order of the Golden Crown from the German Emperor, and in the following year was appointed a Companion of the Order of St. Michael and St. George. He was promoted to be Knight Commander in 1886.

Major-General Sir H. E. Colville, K.C.M.G., C.B.

We regret to announce the death of Major-General Sir Henry Colville as the result of a motor-bicycle accident at Frimley on November 24. In the course of a long and distinguished military career, Sir Henry Colville saw a good deal of active service, mostly in various parts of Africa. Two journeys which he undertook in a private capacity at an early stage of his career are also of some geographical interest. In the closing weeks of 1879 and the early days of the following year, he travelled over the little-known route between Fez and Ujda, publishing an account of his experiences under the title, 'A Ride in Petticoats and Slippers' (1880); and in 1883, after a period of staff service in Cape Colony, made a route survey of the country between the head of the Gulf of Suez and the head of the Gulf of Akabah, and from the latter point up to the neighbourhood of the Dead sea. This latter journey he described in a volume entitled 'The Accursed Land' (1884). The next few years were occupied in active service in the Sudan campaigns, of which he was selected to write the official history, published in 1889. It was during these years that he gained the Companionship of the Bath. After participating in one of the Burma campaigns, he was called to Africa to assist in laying the foundations of British rule in Uganda. For a time he was Acting Commissioner, and directed the military operations against Kabarega, King of Unyoro. He himself personally covered the country between the northern end of the Victoria Nyanza and the Albert Nyanza, and received, in recognition of his services, first the C.M.G. and then the K.C.M.G. Order. Another sprightly volume from his pen, 'The Land of the Nile Springs,' described his experiences during this period. At the beginning of the South African war, Sir Henry Colville commanded the Guards Brigade and later the 9th Division, and the controversy to which his conduct of the operations entrusted to him gave rise no doubt embittered the closing years of his life. Sir Henry became a Fellow of the Society in 1892.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907-1908.

Second Meeting, November 25, 1907.—The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—James Bond Ainsworth; Samuel Aitken; Geoffrey Archer; Paul Baker; Rev. Joseph Barker, M.A., D.D.; His Honour Judge J. W. Barth; Ralph James Dolby Belham; Bertrand Fangeres Bell; Leonard A. Bethell; William
No. I.—JANUARY, 1908.]

Battlescombe Bishop; Cyril Bowden; Percy Bramley; Charles Churchill Branch; Henry William Bush; Señor Don Guillermo R. Calderon; Samuel William Cartwright; Maurice Casenave; Captain Lionel Evelyn Oswald Charlton, D.S.O. (20th Lanes. Fusiliers); George Charlwood; Alexander Smith Cochran; Frederic Abernethy Coleman; John Wallace Collett, M.D.; J. C. Bowen Colthurst; Clive Foster Cooper; Walter William Corner; George Phillip Duolette; R. B. Dunwoody; Joseph Patrick Fagan; Major Geoffrey Feilding, C.G., D.S.O.; W. R. Feldtmann; Ralph Wickham Flower; Harry Halton Fox (H.B.M. Consul, Ichang); John Arthur Freeman; J. Freundlich; Commander Cyril Moulden Fuller, R.N.; Francis John Childs (Ganzoni); Captain G. J. P. Geiger (Royal Welsh Fusiliers); Major H. C. C. Gibbings (1st Royal Innis. Fusiliers, retired); Ernest Gibson; F. Bebbington Goodacre; George Lincoln Goodale, M.A., M.D., LL.D.; Major L. C. Gordon, R.G.A.; Thomas Edward Green; Captain Archibald Hay (2nd Batt. Royal Welsh Fusiliers); Lieut. E. James Haddam, R.I.M.; Walter Balls-Hewley, M.A., M.D.; Charles Basil V. Hodgson, B.A.; Lieut. Godfrey Wm. Holdich, R.A.; Captain S. C. Houston, R.G.A.; Lieut. C. K. Howard-Bury (King's Royal Rifles); E. Francis Hyde. Rev Wm Remfrey Hunt; James Hazan Hyde; Miles Irving, J.C.S.; George Douglas Johnston, B.A.; J. K. N. Kabraye; Albert Ernest Kitson; Captain Robert Thomas Lawless; Fredk. Swan Lawrence, Captain W. T. Layard (Northamptonshire Regt.); Alfred Tully Le Fèvre; Herbert Liggins; Lieut. Raphael Lohr, R.N.R.; Theophilus H. Beacom Long, William Wyley Lord; Lieut. C. H. T. Lucas (Royal Berks. Regt.); George A. Macmillan; Captain Walter William MacGregor (Gordon Highlanders), Rev. William Herbert MacKean, M.A., Peter MacQueen, D.D., U.S.; Major Henry John Madocks; Henry Noel Manton, Reuben Manton; Frederick Wm. Mitchell, Brig.-General B. R. Milford, C.B., D.S.O., C. A. W. Monckton; Lieut. M. R. C. Nanson, R.G.A.; Captain H. D. Pearson, R.E.; Robert Sutherland Rattray, Edward Arthur Read; Robert Renwick, Walter Francis Robinson; Otto Rothfield, I.C.S.; Captain R. S. Sethald; Major Louis Livingstone Seaman; Major Herbert L. Showers, C.I.E., I.A., Commander Alexander Simpson; Alexander Gilbert Smith, Robert C. Sticht, Rev. Hugh Wilson Tegart; Harold Lincoln Tangye; W. R. Taylor; Tsongloom Yutn Teajan; John Erskine Thomson, M.B., D.Ph.; Lieut. Raymond George Waeell-Paaston, C.G.; Wm. Welch; Captain J. R. L. Williams; Lieut. A. T. Wilson (Sikh Pioneers); David Miller Wilson, M.D.; St. John Winne; William McMichael Woodworth, A.B., A.M., Ph.D.; James Carleton Young.

SIR LEOPOLD M'CLINTOCK.

The PRESIDENT said: Since we met here last, a fortnight ago, the country has lost, by the death of Admiral Sir Leopold M'Clintock, one of the finest and simplest characters of our time. I do not propose to say much about his life, because I belong almost to a younger generation (although I had the honour of being a friend of his), and I am not connected either with the Navy or with Arctic exploration; there are many living, many in our Society, who are far better qualified than I am to speak of that intrepid and gallant sailor and explorer. Sir Clements Markham has promised to write an obituary of Sir Leopold M'Clintock, which will appear in the January number of our *Journal*, and will deal fully with his career. I will only remind you that last summer we celebrated the sailing of the *Fox* under his command in search of the Franklin Expedition; and you will remember that Sir Leopold became famous on his return some forty-seven years ago, having successfully solved the problem of its fate. I will only say one or two words as to his long and close connection with our Society. He joined it in the year 1860, on his

return from his Arctic expedition. He was, therefore, forty-seven years a Fellow of the Society. During half that time he was a member of the governing Council, and for a considerable period he was a Vice-President. Even after he became an octogenarian he took an active and leading part in the joint committee of the Royal Society and the Royal Geographical Society, which directed the organization of the National Antarctic Expedition commanded by Captain Scott. In his own profession, the ranks of which teem with men of courage, energy, and devotion, he was, as we all know, looked upon as a shining light, and his long life, in all its phases, was a constant and practical response to that ever-flying signal, "England expects every man to do his duty."

The paper read was :—

"The Exploration of the Nun-Kun Mountain Group and its Glaciers." By Dr. W. Hunter Workman.

RESEARCH DEPARTMENT.

November 15, 1907. The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

The paper read was :—

"Experiments on the Transporting Power of Sea Currents." By Dr. John S. Owen.

Third Meeting, December 9, 1907. The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—John Abercromby Alexander; Francis Henry Anderson; Edmund Armstrong; Mervyn Worcester Howard Beech; Prof. Henry Freer Bray; Edward Lyall Bristow; Ernest Colville; James Fairgrieve, M.A.; F. W. Gard; Prof. Joseph Clark Hoppin, Ph.D.; John Hotchkiss; Lieut. H. G. Howell, R.F.A.; Frederick Kerr; Captain Chas. A. J. S. Langdale (Duke of Wellington's Regt.); George Scott Lowe; George W. Murray; Lieut. C. Patterson (Lancs. Fusiliers); C. Ernest Pearson; Harold Porter; Albert Ritter; Lieut. Alexander Ross-Hume (The Cameronians); Hugh A. Saunders; Lieut. E. C. Smith; Percy K. Stothert; Lieut.-Colonel George Waters.

The paper read was :—

"The Jamaica Earthquake and After." By Dr. Vaughan Cornish.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., Librarian, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full :—

A. = Academy, Academie, Akademie.
 Abb. = Abhandlungen.
 Ann. = Annals, Annales, Annalen.
 B. = Bulletin, Bollettino, Boletim.
 Col. = Colonies.
 Com. = Commerce.
 C.R. = Comptes Rendes.
 E. = Erdkunde.
 G. = Geography, Géographie, Geografia.
 Ges. = Gesellschaft.
 I. = Institute, Institution.
 Iz. = Izvestiya.
 J. = Journal.
 Jb. = Jahrbuch.
 k.k. = kaiserlich und königlich.
 M. = Mitteilungen.

Mag. = Magazine.
 Mem. (Mém.) = Memoirs, Mémoires.
 Met. (mét.) = Meteorological.
 P. = Proceedings.
 R. = Royal.
 Rev. (Riv.) = Review, Revue, Rivista.
 S. = Society, Société, Selakab.
 So. = Science(s).
 Sitzb. = Sitzungsbericht.
 T. = Transactions.
 Ts. = Tijdschrift, Tidekrift.
 V. = Verein.
 Verh. = Verhandlungen.
 W. = Wissenschaft, and compounds.
 Z. = Zeitschrift.
 Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Austria—Istria. *G. Abhandlungen* 9 (1907): Heft 2, pp. iv. and 166. **Krebs.**
 Die Halbinsel Istrien. Landeskundliche Studie von Dr. Norbert Krebs. *With Map, Illustrations, and Sections. Two Copies.*

Europe. **Moryson.**
 An Itinerary, Containing His Ten Yeeres Travell through the Twelve Dominions of Germany, Bohmerland, Switzerland, Netherland, Denmark, Poland, Italy, Turkey, France, England, Scotland, and Ireland. Written by Fynes Moryson. Vols 1 and 2. Glasgow: J. Maclehose & Sons, 1907. Size 9 × 6, pp. (vol. 1) xxvi. and 468, (vol. 2) viii. and 466. *Facsimile Plans. Price 12s. 6d. net per vol Presented by the Publishers.*

The original edition of this famous book is so scarce that this excellent reprint is particularly welcome. It is to be completed in four volumes.

France—Historical. **Brette.**
 Armand Brette. Les limites et les divisions territoriales de la France en 1789. Paris: E. Cornély et Cie., 1907. Size 10 × 6½, pp. viii. and 131. *Maps. Price 3 fr. 50c. Presented by the Publishers.* [To be reviewed.]

Italy—Lake Garda. *Abriégé B.S. Hongroise* 6, 35 (1907): 30-32. **Prinz.**
 Die Brandung am Ufer des Garda-Sees. Von Dr. G. Prinz. (*Földrajzi Közlemények* 35 (1907): 89-96. *With Illustrations.*)

Italy—Ornithology. **Giglioli.**
 Avifauna Italica. Nuovo elenco sistematico delle specie di uccelli stazionare, di passaggio o di accidentale comparsa in Italia. . . compilato dal dottore Enrico Hillyer Giglioli. Florence, 1907. Size 9½ × 6½, pp. xxiv. and 781. *Presented by the Author.*

Italy—Sardinia. *C.R.A. Sc. Paris* 144 (1907). 1182-1185. **Deprat.**
 Les volcans du Logudoro et du Campo d'Ogieri (Sardaigne). Note de G. Deprat.

Italy—Sicily—Etna. **Lorenzo.**
 Giuseppe de Lorenzo. L'Etna. Bergamo: Istituto Italiano d'arti Grafiche, 1907. Size 10½ × 7½, pp. 154. *Illustrations. Price 5s.*

The excellent illustrations give a good idea of the physical features of the mountain.

Italy—Tuscany. **Hutton.**
 Florence and the cities of northern Tuscany, with Genoa. By Edward Hutton. London: Methuen & Co., 1907. Size 8 × 5, pp. x. and 436. *Sketch-map and Illustrations. Price 6s. Presented by the Publishers.*

Italy—Vesuvius. *Popular Sc. Monthly* 69 (1906) 558-566. **Eastman.**
 Vesuvius during the Early Middle Ages. By Dr. Charles R. Eastman. *With Facsimile Illustrations.*

- Luxemburg.** *Tour du Monde* 18 (1907): 193-216. **Sixemonts.**
Le Grand-Duché de Luxembourg. Par Pierre Sixemonts. *With Sketch-map and Illustrations.*
- Mediterranean.** *Ann. G.* 16 (1907): 97-116. **Cayeux.**
Fixité du niveau de la Méditerranée à l'époque historique. Par L. Cayeux. *With Plan and Section.*
- Mediterranean.** **Philipsson.**
Das Mittelmeergebiet: seine geographische und kulturelle Eigenart. Von Alfred Philipsson. Zweite Auflage. Leipzig: B. E. Teubner, 1907. Size 9 × 6, pp. x. and 262. *Maps and Illustrations.* Price 7m. *Presented by the Publisher.*
The first edition of this work was noticed in the *Journal*, vol. 24, p. 343. Some minor improvements have now been incorporated.
- Rumania.** *J.R. Statisticol S.* 70 (1907): 122-129. **Gaster.**
Roumania's forty years' progress, 1866-1906. By Leon Gaster.
- Russia.** **Kirchhoff & others.**
Länderkunde von Europa, herausgegeben . . . von Alfred Kirchhoff. Dritter Teil: Russland, von Prof. Dr. A. von Krassnow in Verbindung mit Prof. Dr. A. Woiikow. (Unser Wissen von der Erde, . . . herausgegeben von Alfred Kirchhoff: iv. Band.) Leipzig: G. Freytag, 1907. Size 11 × 7½, pp. viii. and 336. *Sketch-maps and Illustrations.* Price 22m. [To be reviewed.]
This well-known work is now completed after a long interval.
- Russia—Arkhangelsk.** *B.A. Imp. Sc., St. Pétersbourg*, 1907: 205-208. **Chernesheff.**
Quelques nouvelles données sur la géologie de la Bolchese-molskaïa Toundra. Par F. N. Chernesheff. [In Russian.]
- Russia—Cartography.** *M.G. Ges. Hamburg* 23 (1907): 125-172. **Michow.**
Weitere Beiträge zur älteren Kartographie Russlands. Von H. Michow. *With Facsimile Maps.*
A continuation of the author's former study of the early cartography of Russia.
- Russia—Finland.** **Leiviskä.**
Ueber die Oberflächenbildungen Mittel-Ostbottniens und ihre Entstehung. Von I. Leiviskä. Helsingfors, 1907. Size 9½ × 6½, pp. 114. *Maps and Illustrations.* *Presented by the Author.*
- Servia.** *Deutsche Rundschau G.* 29 (1907): 405-416. **Schlesier.**
Ergebnisse einer Wanderung durch Serbien. Von Emil Schlesier. *With Illustrations.*
- Spain.** **Bartoli.**
Atlas geográfico Ibero-Americano. [Tomo i.] España: descripción geográfica y estadística de las provincias españolas, con el número de habitantes, edificios y viviendas de cada Ayuntamiento, según resulta de los datos provisionales del Censo de 1897. Índice alfabético de los Ayuntamientos con la población de 1901. Por Manuel Escudo Bartoli. Barcelona, [not dated]. Size 15 × 10½, pp. 536. *Purchased.*
Letterpress accompanying an atlas of Spain.
- Switzerland—Census.**
Schweizerische Statistik. 154. Lieferung. Ergebnisse der eidg. Betriebszählung vom 9. August, 1905. Band I. Die Betriebe und die Zahl der darin beschäftigten Personen. Heft 2. Kanton Bern. Bern, 1907. Size 11 × 8½, pp. xvi. and 496.
- Switzerland—Glaciation.** *Jahresber. G. Ges. Bern* 20 (1905-6): 1-230. **Nussbaum.**
Die eiszeitliche Vorgletscherung des Saanagebietes. Von Dr. Fritz Nussbaum. *With Maps and Sections.*
- Switzerland—Languages.** *Questions Diplomatiques* 23 (1907): 423-431. **Henry.**
Enquête en Suisse sur les régions linguistiques allemandes, françaises, italiennes et romanches. Par René Henry. *With Map.*
- Switzerland—Valais.** *Scottish G. Mag.* 23 (1907): 169-191, 225-239. **Newbigin.**
The Swiss Valais: a study in regional geography. By Marion J. Newbigin. *With Maps, Illustrations, and Diagrams.*
- Turkey—Albania.** **Noposa.**
Das katholische Nordalbanien. Eine Skizze von Dr. Franz Baron Noposa. (Separat aus "Földrajzi Közlemények," Budapest.) Vionna, [not dated]. Size 9½ × 6½, pp. 56. *Maps and Illustrations.* *Presented.*

United Kingdom—Coasts.

Royal Commission on Coast Erosion. Vol. 1, Parts i. and ii. Report, Minutes of Evidence, and Appendices thereto, of the Royal Commission appointed to inquire into and to report on certain questions affecting coast erosion and the reclamation of tidal lands in the United Kingdom. London, 1907. Size 13 x 8½, pp. (Part i.) vi.; (Part ii.) vi., 504, iv., and 156. *Plans. Price 1d. and 8s. 9d. Presented by the Royal Commission.* [To be noticed elsewhere.]

United Kingdom—Cornwall. *Quart. J. Geol. S.* 63 (1907): 106-123. **Jukes-Browne.**

The age and origin of the plateaus around Torquay. By Alfred John Jukes-Browne. *With Maps and Sections.*

United Kingdom—Leicester**Johnson.**

Glimpses of ancient Leicester, in six periods. By Mrs. T. Fielding Johnson. 2nd edition. London: Simpkin & Co., 1906. Size 9 x 5½, pp. xvi. and 440. *Plans and Illustrations.*

This edition was prepared in connection with the visit of the British Association

United Kingdom—Population.

Board of Agriculture and Fisheries. Report on the decline in the agricultural population of Great Britain, 1881-1906. London, 1906. Size 9½ x 6, pp. 141. *Map. Price 8d.*

United Kingdom—Scotland. *P.R.S. Edinburgh* 27 (1906-7): 14-15. **Wedderburn.**

The temperature of the fresh-water lochs of Scotland, with special reference to Loch Ness. By E. M. Wedderburn.

United Kingdom—Wales.**Strahan.**

Memoirs of the Geological Survey—England and Wales. The Geology of the South Wales Coalfield. Part ix. West Gower and the country around Pembrey. By Aubrey Strahan. London, 1907. Size 9½ x 6, pp. vi and 50. *Map.*

ASIA.**Central Asia.****Fraser.**

The marches of Hindustan: the record of a journey in Thibet, Trans-Himalayan India, Chinese Turkestan, Russian Turkestan, and Persia. By David Fraser. Edinburgh: W. Blackwood & Sons, 1907. Size 9 x 5½, pp. xvi. and 522. *Map, Profile, and Illustrations. Price 21s. net. Presented by the Publishers.* [To be reviewed.]

Chinese Empire.**Bruce.**

In the footsteps of Marco Polo: being the account of a journey overland from Simla to Peking. By Major Clarence Dalrymple Bruce. Edinburgh, etc. Blackwood & Sons, 1907. Size 9 x 5½, pp. xiv. and 380. *Map and Illustrations. Price 21s. net. Presented by the Publishers.*

See Reviews, ante, p. 92.

Chinese Empire—Railways**Kent.**

Railway enterprise in China: an account of its origin and development. By Percy Horace Kent. London: E. Arnold, 1907. Size 9 x 5½, pp. xii. and 304. *Maps. Price 12s. 6d. net. Presented by the Publisher.*

Chinese Empire—Tibet.**Francke.**

A history of Western Tibet; one of the unknown empires. By Rev. A. H. Francke. London: S. W. Partridge & Co., [1907]. Size 7½ x 5, pp. xiv. and 192. *Sketch-maps and Illustrations. Price 2s. 6d. net. Presented by the Publishers.* [To be reviewed.]

India.**Elwin.**

Indian jottings, from ten years' experience in and around Poona city. By Edward F. Elwin. London: John Murray, 1907. Size 9 x 5½, pp. xii. and 314. *Illustrations. Price 10s. 6d. net. Presented by the Publisher.*

India—Phytogeography.**Hooker.**

A sketch of the flora of British India. By Sir Joseph D. Hooker. (Reprinted from the third edition of the 'Imperial Gazetteer.') Oxford: Clarendon Press, 1906. Size 8½ x 5½, pp. 60. *Presented by the Publishers.*

India—Travancore.**Aiya.**

The Travancore State Manual. By V. Nagam Aiya. 3 vols. Trivandrum, 1906.

Size $10\frac{1}{2} \times 7$. *Map, Plans, and Illustrations. Presented by the Secretary of State for India.*

A valuable compendium of present-day knowledge of the state, its archæology, history, religion, etc.

Japan.

Chamberlain and Mason.

A handbook for travellers in Japan, including the whole empire from Saghalien to Formosa. By Basil Hall Chamberlain and W. B. Mason. 8th edit. London: John Murray, 1907. Size $7 \times 4\frac{1}{2}$, pp. x. and 570. *Maps, Plans, and Illustrations.* Price 20s. Presented by the Publisher

Persia.

Petermanns M. 53 (1907): 121-132.

Stahl.

Reisen in Nord- und Westpersien. Von A. F. Stahl. With Map

Persian Gulf and Persia. M.G. Ges. Hamburg 22 (1907): 69-124.

Stürken.

Reisebriefe aus dem Persischen Golf und Persien Von Alfred Stürken. With Illustrations.

Philippines.

Globus 91 (1907): 271-272.

Kurtz.

Kenzeichen von Niveauänderungen in den Philippinen. Von Kapitänleutnant Kurtz. With Illustrations.

Russia—Steppes.

Ivchenko.

La région périphérique du paysage des déserts en partie N. de la steppe de Kirghiz. Par A. Iwtschenko (Extrait de l'*Annuaire géologique et minéralogique de la Russie*, vol. 6, livr. 4 5.) [St. Petersburg], 1903. Size $12\frac{1}{2} \times 10$, pp. 103-114. [In Russian, résumé in French.]

Russia—Steppes.

Ivchenko.

La dénudation de la steppe. Par A. Iwtschenko. Three parts. (Extrait de l'*Annuaire géologique et minéralogique de la Russie*, vol. 7, livraisons 2 and 7, et vol. 8, livr. 6-7) St. Petersburg, 1906. Size $12 \times 9\frac{1}{2}$, pp. (part i.) 43-59; (part ii.) 216-240; and (part iii.) 135-197. Illustrations. [In Russian, résumé in French.]

See Review in vol. 30, p. 553.

Siam—Survey.

Siam: General Report on the Operations of the Royal Survey Department, 1904-1905. Bangkok, 1906. Size $13 \times 8\frac{1}{2}$, pp. iv. and 56. *Maps and Illustrations.*

Turkey—Arabia Petrea. National G. Mag. 18 (1907): 283-291.

Hoskins.

The Rock City of Petra. By Franklin E. Hoskins. With Illustrations.

Turkey—Palestine.

Macalister and Masterman.

Palestine Explor. Fund, Quart. Statement (1907): 91-130

Diary of a Visit to Safed. By R. A. Stewart Macalister, with travel-notes of the journey from Nablus to Safed *via* Beisan. By Dr. E. W. G. Masterman. With Illustrations.

Turkey—Railway. Z. Ges. E. Berlin (1907): 218-245, 288-320.

Blanckenhorn.

Die Hedschâz-Bahn auf Grund eigener Reise Studien. Von Prof. Dr. Max Blanckenhorn. With Maps and Illustrations.

Western Asia. B. Comité Asie française 7 (1907): 193-197.

Lacoste.

Conférence du Commandant de Lacoste [sur un voyage autour de l'Afghanistan]. With Map.

AFRICA.

Abyssinia.

Skinner.

Abyssinia of to-day: an account of the first mission sent by the American Government to the court of the King of Kings. By Robert P. Skinner. London: E. Arnold, 1906. Size $9 \times 5\frac{1}{2}$, pp. xvi. and 228. *Sketch-map and Illustrations.* Price 12s. 6d.

See review in vol. 29, p. 76.

Africa.

Lander.

Across Widest Africa: an account of the country and people of eastern, central, and western Africa, as seen during a twelve months' journey from Djibuti to Cape Verde. By A. Henry Savage Lander. 2 vols. London: Hurst & Blackett, 1907. Size $10 \times 6\frac{1}{2}$, pp. (vol. 1) xvi. and 396; (vol. 2) xii. and 512. *Map and Illustrations.* Price 42s. net. Presented by the Publishers. [To be reviewed.]

Africa.**Heaton.**

A scientific geography. V. Africa. By Ellis W. Heaton. London: Ralph, Holland, & Co., [1907]. Size $7\frac{1}{2} \times 5$, pp. xvi. and 424. *Sketch-maps and Diagrams.* Price 1s. 3d. *net.* Presented by the Publishers.

Africa.**Hall.**

A woman's trek from the Cape to Cairo. By Mary Hall. London: Methuen & Co., [1907]. Size $9 \times 5\frac{1}{2}$, pp. xvi. and 424. *Maps and Illustrations.* Price 16s. *net.* Presented by the Publishers. [See review, ante, p. 94]

Central Africa.**Schillings.**

In wildest Africa. By C. G. Schillings. Translated by Frederic Whyte. 2 vols. London: Hutchinson & Co., 1907. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. xiv., viii., and 716. *Illustrations.* Price 24s. *net.* Presented by the Publishers. [To be reviewed.]

Congo State.**Frobenius**

In Schatten des Kongostaates. Bericht über den Verlauf der ersten Reisen der D.I.A.F.E. [Deutschen Inner-Afrikanischen Forschungs-Expedition] von 1904-1906, über deren Forschungen und Beobachtungen auf geographischen und Kolonialwirtschaftlichem Gebiet, herausgegeben und bearbeitet von Leo Frobenius. Berlin: Georg Reimer, 1907. Size $10\frac{1}{2} \times 7$, pp. xiv. and 408. *Maps and Illustrations.* Price 14m. Presented by the Publisher. [To be reviewed.]

Egypt and Sudan.**Hall.**

Handbook for Egypt and the Sudan. Edited by H. R. Hall. 11th edition. London: Stanford, 1907. Size $7 \times 4\frac{1}{2}$, pp. xiv., 170, 614. *Maps, Plans, and Illustrations.* Price 14s. Presented by the Publisher

Eritrea.*Riv. G. Italiana* 14 (1907): 129-141. **Dainelli and Marinelli.**

Del Marahò: vulcano estinto della depressione Dancala. Osservazioni di G. Dainelli ed O. Marinelli. With Map, Sections, and Illustrations.

French Sudan.*La G., B.S.G. Paris* 15 (1907): 253-260.**Villatte.**

Le régime des eaux dans la région lacustre de Goundam (dépression Faguibine-Daounas-Télé-Fati) Par le Lieutenant Villatte With Map and Section.

German East Africa.**Kohlschütter.**

Ergebnisse der Ostafrikanische Pendel-Expedition der Königl. Gesellschaft der Wissenschaften zu Göttingen in den Jahren 1899 und 1900, ausgeführt von Hans Glauning und Ernst Kohlschütter Bearbeitet von Dr. Ernst Kohlschütter. 1 Band. Berlin, 1907. Size $11 \times 8\frac{1}{2}$, pp. viii and 230. *Map and Diagrams* Presented by the Author.

German East Africa—Communications.**Prager.***Z. Kolonialpolitik, etc.* 9 (1907) 203-210.

Der Wasserweg zum Nyassasee. Von M. Prager.

German East Africa—Trade. *Z. Kolonialpolitik, etc.* 9 (1907): 431-451**Hermann.**

Die Abschneürung Sansibars von Deutschostafrika. Von Dr. Rud. Hermann.

Discusses the commercial relation of Zanzibar to the opposite continental area which is compared with that of England to Western and Central Europe.

Madagascar—Ethnology. *Rev. Madagascar* 9 (1907): 81-91**Ferrand.**

Le peuplement de Madagascar Par Gabriel Ferrand.

Madagascar—Geology. *Rev. Madagascar* 9 (1907): 92-102.**Lemoine.**

Etat actuel de nos connaissances sur la géologie de Madagascar. Par P. Lemoine.

See note on these two papers in the August number (p. 214).

Morocco—Ujda.*Rev. française* 32 (1907): 219-231.**Mougin.**

Oujda. (D'après le capitaine Mougin.) With Plan.

Natal.**Anderson.**

Natal: Surveyor-General's Department. Third and final report of the Geological Survey of Natal and Zululand. By William Anderson. London, 1907. Size 12×8 , pp. 300. *Maps and Plates* Presented by the Agent-General for Natal.

Nigeria.*Petermanns M.* 53 (1907): 108-111.**Marquardsen.**

Zur Karte des Gebiets zwischen Ibi und Yola. Von Hauptmann Hugo Marquardsen. With Map.

The writer traversed the districts south of the Benue, both in German and English territory, in 1903.

North-West Africa—Trade. *G.Z.* 13 (1907): 126-142, 174-185. **Kürchhoff.**
 Alte und neue Handelsstrassen und Handelsmittelpunkte in Nordwest-Afrika.
 Von D. Kürchhoff.

Rhodesia—Archæology. **Lamplugh and Balfour.**
 Notes on the occurrence of stone implements in the valley of the Zambesi around Victoria Falls. By G. W. Lamplugh. Note on an implement of palæolithic type from the Victoria Falls; Zambesi. By H. Balfour. (From the *Journal of the Anthropological Institute*, vol. 36, January-June, 1906.) London, 1906. Size 11 × 7½, pp. 159-171. *Maps and Illustrations. Presented by the Authors.*

Rhodesia—Historical. **Hall.**
 The prehistoric gold mines of Rhodesia. By R. N. Hall. (Reprinted from the *African Monthly*.) Grahamstown: African Book Co., 1907. Size 9½ × 6½, pp. 46. *Presented by the Author.*

An answer to Mr. McIver, in which the author endeavours to show that the gold was not extracted between 900 and 1760 A.D. Certain at least of Mr. McIver's statements seem to be successfully refuted.

Rhodesia—Zambesi. **Lamplugh.**
 The geology of the Zambesi Basin around the Batoka Gorge. By G. W. Lamplugh. (From the *Quarterly Journal of the Geological Society*, vol. 63, 1907.) Size 8½ × 5½, pp. 162-216. *Map and Sections. Presented by the Author.*

Sahara. *La G., B.S.G. Paris* 15 (1907): 261-270. **Chudeau.**
 D'Alger à Tombouctou par l'Ahaggar, l'Aïr et le Tchad. Par R. Chudeau. *With Map.*

Sahara. *Ann. G.* 16 (1907): 46-69, 117-138. **Gautier.**
 Études Sahariennes. Par E. F. Gautier. *With Map and Illustrations.*

Sahara. *Renseignements Col., Comité Afrique française* (1907): 77-90. **Laperrine.**
 La tournée à Taoudeni du Lieut.-Colonel Laperrine (26 mars--9 juillet, 1906). *With Map.*

Sahara. *Rev. française* 32 (1907): 273-283. **Mangin.**
 Région du Tchad: le Borkou. (Rapport du capitaine Georges Mangin.)

Sahara. *Renseignements Col., Comité Afrique française* (1907): 53-57, 102-106. **Mussel.**
 Du Touat à l'Accegrath et à l'Ahnnet. Rapport de tournée du Lieut. Mussel.

Sahara—Ethnology. *Globus* 91 (1907): 379-384. **Goldstein.**
 Die Thesaurierungspolitik der Saharabevölkerung. Von Ferdinand Goldstein
 The author treats of the camel in the rôle of personal property.

Sierra Leone. *Jahresber. G. Ges. Bern* 20 (1905-6): 231-249. **Volz.**
 Eine Reise an die Flüsse Kittum und Bum in Sierra Leone. Von Dr. Walter Volz.

Somaliland—British. **Herbert.**
 Two Dianns in Somaliland: the record of a shooting trip. By Agnes Herbert. London: John Lane, 1908 [1907]. Size 9 × 6, pp. viii and 306. *Illustrations. Price 12s. 6d. net. Presented by the Publisher* [See notice on p. 100, ante.]

South Africa. **Theal.**
 History and ethnography of Africa south of the Zambesi, from the settlement of the Portuguese at Sofala in September, 1505, to the conquest of the Cape Colony by the British in September, 1795. By Dr. George McCall Theal. Vol. 1, The Portuguese in South Africa from 1505 to 1700. London: Sonnenschein & Co., 1907. Size 9 × 5½, pp. xxiv. and 502. *Map, Facsimile Plan, and Illustrations. Price 7s. 6d. Presented by the Publishers.*

This volume inaugurates a third edition, greatly extended in some directions, of the author's classical work on South Africa.

South Africa—Geology. **Corstorphine.**
 The geological aspects of South African scenery. Presidential address to the Geological Society of South Africa, January 28, 1907. By Dr. Geo. Corstorphine. Johannesburg, 1907. Size 10 × 7, pp. xix-xxvii.
 See note in *Monthly Record*, vol. 30, p. 562.

Sudan. **Alexander.**
 From the Niger to the Nile. By Lieut. Boyd Alexander. 2 vols. London: K.

- Arnold, 1907. Size 9½ × 7, pp. (vol. 1) xvi. and 358; (vol. 2) xii. and 420. *Maps and Illustrations*. Price 36s. net. Presented by the Publisher. [To be reviewed.]
- Transvaal—Agriculture.** *J.R. Col. I.* 38 (1907): 466-486. **Burt-Davy.**
The agricultural and pastoral possibilities of the Transvaal. By Joseph Burt-Davy.
- Tripoli.** *Riv. Coloniale* 3 (1907): 302-315. **Afric.**
I confini e l' "hinterland" della Tripolitania. Di V. R. Afric.
- Tripoli.** *Tour du Monde* 13 (1907): 169-192. **Mathuisieulx.**
La Cyrénaïque. Par H. de Mathuisieulx. With Sketch-map and Illustrations.
- Tunis.** **Loth.**
La Tunisie et l'œuvre du protectorat français. Par Gaston Loth. Paris: Ch. Delagrave, 1907. Size 10 × 6½, pp. 282. *Illustrations and Diagrams*. Price 4 fr. Presented by the Publisher. [To be reviewed.]
- West Africa—Boundary.** *Questions diplomatiques* 23 (1907): 417-422. ———
La mission du Commandant Moll, Congo-Cameroun. By J.-H. F.
See note in vol. 29, p. 676.
- West Africa—Boundary.** *Questions diplomatiques* 23 (1907): 495-498. ———
La mission du Capitaine Cottes, Sud-Cameroun. Par J.-H. F. With Map.
See note in vol. 29, p. 676.
- West Africa—Currency.** *Rev. coloniale* (1907): 145-158. **Baillaud.**
Circulation monétaire en Afrique occidentale. Par Émile Baillaud.

NORTH AMERICA.

- United States—Indian Territory.** *B. American G.S.* 39 (1907): 321-340. **Condra.**
Opening of the Indian Territory. By G. E. Condra. With Map and Illustrations.
- United States—Irrigation.** *National G. Mag.* 18 (1907): 217-243. **Blanchard.**
Millions for moisture: an account of the work of the U.S. Reclamation Service. By C. J. Blanchard. With Illustrations.
- United States—Mounds.** *American J. Sc.* 23 (1907): 245-256. **Hobbs.**
Some topographic features formed at the time of earthquakes and the origin of mounds in the Gulf plain. By Wm. H. Hobbs. With Sections and Illustrations.
See Monthly Record, vol. 30, p. 92.
- United States—New Mexico.** **Lee.**
U.S. Geol. Surv., Water-supply Paper, No. 188 (1907), pp. 60.
Water resources in the Rio Grande valley of New Mexico and their development. By Willis T. Lee. With Maps and Illustrations.
- United States—New York.** *American J. Sc.* 33 (1907): 325-335. **Carney.**
Wave-cut terraces in Kuka valley, older than the recession stage of Wisconsin ice. By Frank Carney. With Illustrations.
- United States—New York.** *B. American G.S.* 39 (1907): 193-199. **Heilprin.**
The Catskill mountains. By Prof. Angelo Heilprin. With Map.
- United States—New York.** *Monthly Weather Rev.* 35 (1907): 109-118. **Merriman.**
Rainfall and run-off of the Catskill mountain region. By Thaddeus Merriman. With Map and Diagrams.
- United States—New York.** *Monthly Weather Rev.* 35 (1907): 8-11. **Horton.**
The Adirondack rainfall summit. By Robert C. Horton. With Map and Profile.
- United States—Population.** *U.S. Bureau Census, B.* No. 71 (1907): pp. 28. ———
Estimates of population, 1904, 1905, 1906.
- United States—South-East.** *P. Boston S. Nat. Hist.* 33 (1907): 211-248. **Johnson.**
Drainage modifications in the Tallulah district. By Douglas Wilson Johnson. With Sketch-maps and Illustrations.
- United States—Swamps.** *National G. Mag.* 18 (1907): 292-301. **Wilson.**
Reclaiming the swamp-lands of the United States. By Herbert M. Wilson. With Map, Illustrations, and Diagram.

United States—Triangulation. *U.S. Geol. Surv., B.* 310 (1907): pp. 248. **Gannett.**
Results of primary triangulation and primary traverse; fiscal year 1905 G. By
Samuel S. Gannett. *With Map.*

United States—Utah. *National G. Mag.* 18 (1907): 199-204. **Holmes.**
The great natural bridges of Utah. By Edwin F. Holmes. *With Illustrations.*

CENTRAL AND SOUTH AMERICA.

Chile—Seismology. *Petermanns M.* 53 (1907): 132-138. **Steffen.**
Einige Ergebnisse der Untersuchungen über das mittelhilenische Erdbeben vom
16. August 1906. Von Dr. Hans Steffen. *With Map.*

Costa Rica—Cocos Island. **Biolley.**
Museo Nacional de Costa Rica. Mollusques de l'Île de Coco. Par P. Biolley.
(Résultats d'une expédition faite en janvier 1902, du 11 au 16, sous les auspices du
Gouvernement de Costa Rica.) San José, 1907. Size 12 × 8½, pp. 30. *Map and
Illustration.*

The writer visited the island, which lies midway between Central America and the
Galapagos, for zoological research. He gives some notes on its physical and faunal
relations.

Panama—Canal. **[Waldo.]**
The present status of the Panama Canal. [By Fullerton L. Waldo.] (Reprinted
from *Engineering*, March 15, 1907.) London, 1907. Size 8½ × 5½, pp. 16. *Illustra-
tions.*

Peru—Climatology. *Meteorologische Z.* 24 (1907): 270-279. **Hann**
Zum Klima von Peru. (Mit Beobachtungen auf dem Mistigipfel in 5852 m.) Von
J. Hann. *Also separate copy.*

Peru—Coast-line. *C.R.A. Sc. Paris* 144 (1907): 1180-1182. **Berthon.**
Contribution à l'étude des oscillations du rivage dans la baie du Callao. Note de
P. Berthon.

South America—Ethnology. **Schuller.**
Sobre el orijen de los Charrúa. Replica al Dr. J. Friederici, de Leipzig. Por R.
R. Schuller. Santiago, 1906. Size 10 × 6½, pp. 158. *Map. Presented by the
Author.*

The Charrua Indians now occupy parts of Uruguay.

West Indies—Jamaica. *Popular Sc. Monthly* 70 (1906): 385-403. **Brown**
The Jamaica earthquake. By Prof. Charles W. Brown. *With Maps and Illustra-
tions.*

West Indies—Jamaica.
Correspondence relating to the Earthquake at Kingston, Jamaica, on January 14,
1907. Size 13 × 8½, pp. xviii. and 120. *Plan Price* 1s. 5d. London, 1907.

West Indies—Jamaica. *J. Manchester G.S.* 22 (1906): 113-134. **Mellor.**
Jamaica, the Crown of our West Indian possessions. By E. W. Mellor. *With Illus-
trations.*

POLAR REGIONS.

Arctic Ocean.

Arctic Pilot. Vol. 1. Comprising the northern coasts of Russia from Voriema or
Jacob river in Europe, to Cape North and the Wrangell islands in Asia, including
a portion of the Arctic ocean, with the Barents, White, and Kara seas. Originally
compiled by Commander H. S. Penn. Second edit. London, 1907. Size
9½ × 6, pp. xxxii. and 380. *Index-charts.*

Greenland. *Meddelelser om Grønland* 30 (1907): pp. xiv. and 1-314. **Kruuse.**
Botanical exploration of the east coast of Greenland between 65° 35' and 74° 30'
lat. N. By Chr. Kruuse.

Polar Exploration. *G. Anzeiger* 3 (1907): 49-54. **Drygalski.**
Ziele und Methoden der Polarforschung nach den Verhandlungen des inter-
nationalen Kongresses zur Erforschung der Polargebiet in Brüssel. Von Erich
von Drygalski. *With Map.*

Spitzbergen.*Monthly Weather Rev.* 35 (1907): 68-68.

Meteorological work at Camp Wellman, Danes Island, Spitzbergen.

On the work done by Mr. Hersey as a member of the Wellman expedition of 1906.

MATHEMATICAL GEOGRAPHY.**Longitudes.****Klotz.**

Department of the Interior, Canada. Transpacific Longitudes between Canada and Australia, and New Zealand, executed during the years 1903-1904. By Dr. Otto Klotz. Ottawa, 1907. Size $10 \times 6\frac{1}{2}$, pp. 31-198. *Map, Diagrams, and Illustrations.* Presented by the Author.

Surveying.*U.S. Geol. Surv., B.* 306 (1906). pp. 88.**Gannett.**Manual of Topographic Methods. By Henry Gannett. *With Illustrations.***Surveying.***Petermanns M.* 53 (1907): 97-108.**Hammer.**

Ueber die Bestrebungen der neueren Landestopographie. Von Prof. Dr. E. Hammer. *With Map.*

Surveying.**Larminat.**

E. de Larminat. Topographie pratique de reconnaissance et d'exploration, suivie de notions élémentaires pratiques de géodésie et d'astronomie de campagne. 2^e édition. Paris: H. Charles-Lavauzelle, (1907). Size $9 \times 5\frac{1}{2}$, pp. 392 and 32. *Sketch-maps and Diagrams.* Presented by the Author.

See Review in the August number, p. 206.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.**Geophysics.****Ricciardi.**

L'unità delle energie cosmiche. Di Leonardo Ricciardi. Turin, etc., [1907] Size $10 \times 6\frac{1}{2}$, pp. 56. Presented by the Author.

The author thinks (*inter alia*) that the warm ocean currents are derived from the interior of the Earth, into which the seawater has percolated.

Geophysics.*G.Z.* 13 (1907) 169-174.**Tertsch.**

Neuere Versuche zur physikalischen Lösung des Problems vom Erdinnern. Von H. Tertsch. *With Diagram.*

Glaciology—Erosion.**Früh.**

Ueber Form und Grosse der glazialen Erosion. Von Prof. Dr. J. Früh. (Separat-Abdruck a. d. Verhandlungen der Schweizer Naturforschenden Gesellschaft in St. Gallen, 1906.) St. Gallen, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 48. *Maps and Diagrams.* Presented by the Author.

Hydrology.**Barrows and Horton.***U.S. Geol. Surv., Water Supply Paper*, No. 187 (1907): pp. 91

Determination of stream-flow during the frozen season. By H. K. Barrows and Robert E. Horton. *With Illustrations and Diagrams.*

Hydrology.*P.I. Civil Engineers*, 167 (1906-7): 181-185.**Hill.**

The yield of catchment areas. By Ernest Prescott Hill. (Discussion, pp. 186-261.)

Meteorology—Atmosphere.*Petermanns M.* 53 (1907): 138-139.**Supan.**

Die höchste Ballonfahrt. Von Dr. A. Supan. *With Diagram.*

Oceanography—North Atlantic.**Poole.***P. and S. Nova Scotian I. Sc.* 11 (1903-4): 193-198.

The sunken Land of Bus. By Dr. Henry S. Poole. *With Chart.*

The writer (who is not aware that the designation is to be traced to the *Busse* of *Bridgewater*, one of the ships in Frobisher's last voyage) calls attention to soundings near the locality in question by the cable-ship *Minia* in 1903. (Cf. Murray and Peake, in R.G.S. extra publication, 1904.)

Phenology.*J.R. Statistical S.* 70 (1907): 1-51.**Hooker.**

Correlation of the weather and crops. By R. H. Hooker.

Volcanic Phenomena.*C.R.A. Sc. Paris* 144 (1907): 1468-1470.**Martel.**

Sur les gouffres de la mer et la volcanisme. Par E. A. Martel.

The writer urges the importance of studying the question of the penetration of seawater into submarine abysses.

OLDER WORKS ADDED TO THE LIBRARY AND MAP COLLECTION IN 1907.

BOOKS.

- Anville, [J. B. B.] d'.—**Géographie ancienne, abrégée. 3 vols. Size $6\frac{1}{2} \times 4$. *Presented by Sir J. D. Hooker.* Paris, 1782.
- Arctic.**—[Collection of papers relative to the Expedition of 1875-6, commanded by Sir G. Nares.] 2 vols. *Maps and Illustrations.* Size $8\frac{1}{2} \times 5\frac{1}{2}$. *Presented by Sir C. R. Markham.* London, 1865-79.
- Bornhardt, W.**—Zur Oberflächengestaltung und Geologie Deutsch-Ostafrikas. (Deutsch-Ost-Afrika, Band vii.) *Maps and Illustrations.* Size $11 \times 7\frac{1}{2}$. Berlin, 1900.
- Coues, Elliott (Editor).**—History of the expedition under the command of Lewis and Clark. 4 vols. *Maps and Portraits.* Size $9\frac{1}{2} \times 6$. London and New York, 1898.
- De la Martinière, H. M. P., and N. Lacroix.**—Documents pour servir à l'étude du nord ouest africain. Vols. II.-IV. and Atlas. *Maps and Illustrations.* Size $11 \times 7\frac{1}{2}$. [Algiers], 1896-97.
- Dupin, Charles.**—Voyages dans la Grande-Bretagne. 6 vols (bound in 3). Size 10×8 . *Presented by Sir J. D. Hooker.* Paris, 1820-24.
- Forrest, Thomas.**—A voyage from Calcutta to the Mergui Archipelago. *Maps and Illustrations.* Size $13 \times 9\frac{1}{2}$. London, 1792.
- Hergt, G.**—Die Nordlandfahrt des Pytheas. *Map.* Size $8\frac{1}{2} \times 5\frac{1}{2}$. Halle-a.-S., 1893.
- Martius, Dr C. F. P. von.** Beiträge zur Ethnographie und Sprachkunde Amerika's, zumal Brasiliens. Band I. *Map.* Size $8\frac{1}{2} \times 5\frac{1}{2}$. Leipzig, 1867.
- Montandon, C. H.**—Guide du voyageur en Crimée. *Maps and Illustrations.* Size $7\frac{1}{2} \times 4\frac{1}{2}$. *Presented by Sir J. D. Hooker.* Odessa, 1834.
- Müller, Dr H. [Editor].**—Al-Hamdānī's Geographie der Arabischen Halbinsel. 2 vols. [Arabic text and notes only.] Size $9\frac{1}{2} \times 6$. Leyden, 1884-91.
- [**Müller, Saloman.**—Verhandelingen over de natuurlijke geschiedenis der Nederlandsche Overzeesche Bezittingen . . . uitgegeven . . . door C. J. Temminck. [Deel III.] Land- en Volkenkunde, door Salomon Müller. [Plates only, four missing.] Size 13×19 . *Presented by Colonel W. J. Alt.* N.P., 1844.
- Navigation**—The safeguard of sailors, or Great Rutter. Translated . . . by Robert Norman. *Woodcuts.* Size $8 \times 6\frac{1}{2}$. *Presented by Mr. H. Yates Thompson.* London, 1590.
- Navigation**—The Rutter of the sea. . . . [Translated by Robert Copland.] Size $5\frac{1}{2} \times 4$. London, [c. 1560].
- Parry, W.**—A . . . discourse of the travels of Sir Anthony Sherley, by sea and overland to the Persian Empire. Size $8\frac{1}{2} \times 7$. [MS. copy of the edition of] London, 1601.
- Purchas, Samuel.**—Purchas his Pilgrimage, or, Relations of the world, and the religions observed in all ages and places. . . . 4th edition. *Maps.* Size $13\frac{1}{2} \times 8\frac{1}{2}$. London, 1626.
- Vernon-Harcourt, L. F.**—Rivers and canals. 2nd edition. 2 vols. *Maps, Sections, and Illustrations.* Oxford, 1896.

MAP.

Scheuchzer, Johann Jacob. Nova Helvetiæ tabula geographica. 2 sheets. 1712.

NEW MAPS.

By **H. A. REEVES**, Map Curator, R.G.S.

EUROPE.

Austria.

Freytag.

G. Freytag's Touristen-Wanderkarte der Dolomiten. Scale 1:100,000 or 1 inch to 1·6 stat. mile. 2 sheets. Vienna: G. Freytag & Berndt, [1907]. Price 2m. each sheet. *Presented by the Publisher.*

Austria.**Hanslik.**

Siedelungskarte der polnischen Westbeskiden vom Jahre 1900. Gezeichnet von Erwin Hanslik. Scale 1:150,000 or 1 inch to 2.4 stat. miles. Kultur- und Volksdichtekarten der polnischen Westbeskiden. Von Erwin Hanslik. Scale 1:600,000 or 1 inch to 9.5 stat. miles. *Petermanns Mitteilungen, Erzaugungsheft, No. 158, Tafeln 3 u. 4.* Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

England and Wales.**Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from November 1 to 30, 1907.

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England and Wales.**Geological Survey.****4 miles to 1 inch:—**

New series, printed in colours, solid edition. Sheets: (5 and 6), Lancaster, Preston, Wigan, Southport, and the Isle of Man. Drift edition, sheet 16: Cambridge, Colchester, Ipswich, etc. Price 2s. 6d. each

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New series, colour printed. Drift edition, sheet 254: Henley-on-Thames. Price 1s. 6d.

(E. Stanford, London Agent.)

England—London.**Bartholomew.**

Handy Reference Atlas of London and Suburbs. By J. G. Bartholomew, F.R.G.S. Edinburgh: John Bartholomew & Co., 1908 [1907]. Price 2s. 6d. net. Presented by the Publisher.

Although many of the plates of this atlas have appeared before, a considerable amount of time and labour has evidently been spent on their revision, and the result is a decidedly useful little atlas of London for handy reference. A special feature is the excellent index given at the end. In some districts further revision is still necessary to bring the maps up to date.

Europe—Central.**Freytag.**

G. Freytag's Automobil- und Badfahrer-Karton. Scale 1:300,000 or 1 inch to 4·7 stat. miles. Sheets: 9, Provinz Sachsen, Brandenburg; 30, Krain und Kustenland. Vienna: G. Freytag & Berndt, [1907]. Price 1.35m. each. Presented by the Publisher.

France.**Vallot.**

Environs de Chamonix, extraits de la Carte du massif du Mont Blanc, exécuté par Henri Vallot et Joseph Vallot d'après leurs triangulations et levés sur le terrain. Scale 1:20,000 or 3·2 inches to 1 stat. mile. Paris: Henry Barrère, 1907. Presented by the Publisher.

This map of the environs of Chamonix forms part of an entirely new survey of Mont Blanc and the immediate neighbourhood which during the past few years has been carried out by the authors, and the results of which it is intended to publish on a 1:20,000-scale map, consisting altogether of twenty-two sheets, as soon as the work upon the ground is completed. In general appearance this sheet resembles one of the Swiss Government Survey, but is on a larger scale. Contour-lines are given at intervals of 20 metres—on the land in brown, and on glaciers in blue. Roads, rockwork, and lettering are in black. In addition to the contours which are numbered in brown, many absolute heights are given in black figures. Care has been taken to distinguish by symbols the breadth and general character of the roads and tracks. In this edition, which is provisional only, the wooded lands are not indicated; but this will be done later on. The basis of the map is a careful triangulation, undertaken by MM. Henri and Joseph Vallot, and altogether the work is one of considerable merit and importance.

Sweden.**Sveriges Geologiska Undersökning.**

Sveriges Geologiska Undersökning. Scale 1:50,000 or 1·3 inch to 1 stat. mile. Sheets: Ser. Aa, Nos: 123, Jönköping; 131, Svinhult; 137, Västervik; 140, Boxholm. Stockholm. Sveriges Geologiska Undersökning, 1905–1907. Presented by the Swedish Geological Institute.

ASIA.**Indian Government Surveys.****Surveyor-General of India.**

Bengal and Central Provinces. Scale 1 inch to 1 mile. Sheets. 66, parts of districts Palamau and Ranchi (Bengal) and Sarguja State (C.P.), 1907. 92, parts of districts Palamau and Hazaribagh, 1907. 170, part of district Darbhanga, 1907. 181, district Manbhum, 1907. 208, parts of districts Sonthal Parganas, Manbhum, and Hazaribagh, 1907. 210, parts of districts Manbhum, Burdwan, and Bankura, 1907. 211, districts Manbhum and Bankura, 1907. 213, parts of districts Manbhum, Bankura, Midnapore, and Singhbhum, 1907. 237, parts of districts Burdwan, Bankura, and Birbhum, 1907. 238, parts of districts Bankura and Burdwan, 1907. 239, part of district Bankura, 1907. 240, parts of districts Bankura and Midnapore, 1907. 261, parts of districts Burdwan and Bankura, 1907. 262, parts of districts Bankura, Burdwan, and Hughly, 1907. 268, parts of districts Midnapore and Balasore, 1895. 282, parts of districts Murshidabad, Birbhum, and Nadia, 1907. 288, parts of districts Howrah, 24-Parganas, and Midnapore, 1907. 289, parts of districts Howrah, Midnapore, and 24-Parganas, 1907. 306, parts of districts Nadia and Jossore, 1907.—Bombay Survey, scale 1 inch to 1 mile. Sheet 178, parts of districts Dungarpur (Rajputana Agency), Idar, and Sadra (Bombay), 1905.—Burma Survey, scale 1 inch to 1 mile. Sheets: 191, parts of districts Shwabo and Lower Chindwin, 1907. 208, parts of districts Thayetmyo, Taungu, and Yamethin, 1907. 207, parts of districts Prome, Thayetmyo, and Taungu, 1907. 339, 513, parts of Southern Shan States, 1907. 506, 507, parts of Northern and Southern Shan States, 1907.—Burma Survey, scale 1 inch to 4 miles. Sheet 93c, parts of Burma and the North and South Shan States, 1907.—Central India and Rajputana Survey, 1 inch to 1 mile. Sheets: 149, parts of states Dungarpur (Rajputana Agency), Idar and Sadra (Bombay), 1905. 289,

part of state Jaipur (Rajputana Agency), 1905. 318, parts of states Jaipur and Karauli (Rajputana Agency), 1905.—Central Provinces Survey, 1 inch to 1 mile. Sheets: 25, parts of districts Betul and Hoshangabad, 1908. 102, 124, 147, part of district Chanda, 1907. Central Provinces and Berar, 1 inch to 80 miles, 1906.—Madras Survey, 1 inch to 1 mile. Sheets: 78, part of district Mysore (Mysore), 1905. 102 and portion of 134, parts of districts Tumkur and Chitaldroog (Mysore), 1906. 133, parts of districts Chitaldrug and Tumkur (Mysore), 1906.—Punjab Survey, 1 inch to 1 mile. Sheets: 65, parts of districts Mianwali and Muzaffargarh, 1901. 224, parts of district Ferozepur and Faridkot State, 1906. 228, parts of districts Ferozepur and Hissar, 1902.—Sind Survey, 1 inch to 1 mile. Sheet 53, district Karachi, 1906.—Levels in Sind, 1 inch to 2 miles. Sheets 26, 27, districts Karachi, Larkhana, and Hyderabad, 1906.—District Sukkur, 1 inch to 4 miles, 1906.—United Provinces Survey, 1 inch to 1 mile. Sheets: 98, parts of districts Naini Tal, Pilibit, and Kheri, 1907. 122, parts of districts Rae-Bareilly, and Unao, 1905. 130, parts of districts Kheri and Bahraich, 1907. 131, parts of districts Kheri, Sitapur and Bahraich, 1907. 132, parts of districts Kheri, Bahraich and Sitapur, 1907. 141, 146, part of district Bahraich, 1907. 227, 228, part of district Dehra Dun, 1907. Calcutta: Surveyor-General's Office, 1907. *Presented by the Secretary of State for India through the India Office.*

Japan.**Imperial Geological Survey, Tokyo.**

Topographical map of Japan Scale 1: 200,000 or 1 inch to 3·2 stat. miles. Sheets: Kameda, Suzumisaki Tokyo: Imperial Geological Survey, 1907. *Presented by the Imperial Geological Survey of Japan.*

Siberia.**Ahnert and Khlaponin.**

Carte géologique de la région aurifère de la Scémdja. Dressée par A. Khlaponin. Scale 1: 84,000 or 1 inch to 1·3 stat. mile. Sheets. 1 and 2. Carte géologique de la région aurifère de Zéia Dressée par E. Ahnert. Scale 1: 84,000 or 1 inch to 1·3 stat. miles. Sheets: III. 2, III. 3, III. 4. St. Petersburg: Comité Géologique, 1905-07. *Presented by the Comité Géologique, St. Petersburg.*

AFRICA.**Africa.****Bartholomew.**

Central and South Africa. By J. G. Bartholomew, F.R.G.S. Scale 1: 5,000,000 or 1 inch to 79 stat. miles. Edinburgh: John Bartholomew & Co., [1907]. *Price, mounted in cloth, 3s. net. Presented by the Publishers.*

A new edition of a useful general map, with additions and corrections to railways, open and under construction. Seven plans of ports are given as insets. For some unexplained reason, hill-shading is given in the southern part of the map only.

Cape Colony.**Topographical Section, General Staff.**

Cape Colony. Reconnaissance Series. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. Sheets: 128-A, Warmbad; 128-G, Little Bushmanland; 128 L, Strydenburg. London: Topographical Section, General Staff, War Office, 1907. *Presented by the Director of Military Operations.*

Congo State.**Lebègue.**

Carte de l'État Indépendant du Congo. Scale 1: 4,000,000 or 1 inch to 63·1 stat. miles. Brussels: J. Lebègue & Cie., [1907]. *Price 1.50fr.*

Egypt.**Survey Department, Cairo.**

Topographical map of Fayum Province. Scale 1: 10,000 or 6·3 inches to 1 stat. mile. Sheets: s.e. 11-1 and 12-1, 13-2, 14-2, 15-2, 18-1. s.w. 11-1, 12-2, 12-4, 12-5, 12-7, 13-1, 13-5, 13-6, 13-7, 13-8, 13-10, 14-7, 14-8, 14-9 and 10, 14-11, 14-12. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Gold Coast.**Guggisberg.**

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1: 125,000 or 1 inch to 1·9 stat. mile. Sheets: 72-L-III., Kibbi (Kyebi). Edinburgh and London: W & A. K. Johnston, 1907. *Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.*

Orange River Colony.**Murray and Cannon.**

Map of the Orange River Colony, compiled from recent surveys, diagrams, and other reliable sources by A. C. Murray, C.E., and Reginald Cannon, A.M.I.C.E. Scale 1:

253,440 or 1 inch to 4 stat. miles. 4 sheets. Johannesburg: The Drawing Office, 1907. *Presented by A. C. Murray, Esq.*

An uncoloured outline map, without hill-shading, showing farm boundaries, railways, mines, rivers, roads, and other useful information. In its compilation, besides the personal observations and surveys of Mr. A. C. Murray, farm diagrams, and the surveys of railway and mining engineers have been utilized, and the map has been completed from the degree sheets published by the Surveyor-General of the Orange River Colony. The preparation and drawing must have entailed a considerable amount of labour, but the map will doubtless be of great service. It is in four sheets, each measuring 35 inches by 43 inches.

Transvaal.

Murray.

Map of portion of the Zoutpansberg, showing the Messina-Seta district. By A. C. Murray, c.e. Scale 1 : 80,000 or 1 inch to 1.3 stat. mile. Johannesburg: The Drawing Office, 1907. *Presented by A. C. Murray, Esq.*

A blue print showing farm boundaries, mining claim boundaries, discoverers' rights, roads, and rivers and watercourses, compiled from farm surveys under the supervision of mining engineers, prospectors, and others acquainted with the district.

AMERICA.

Canada.

Dept. of the Interior, Ottawa.

Standard topographical map of Canada. Scale 1 : 250,000 or 1 inch to 3.9 stat. miles. Sheets 1 N.W. and 1 N.E. Guelph, Ontario; 15, Cape Breton, Quebec. Ottawa: Department of the Interior, 1906-07. *Presented by the Department of the Interior, Ottawa.*

Canada.

Dept. of the Interior, Ottawa.

Railway map of the Dominion of Canada. Scale 1 : 6,336,000 or 1 inch to 100 stat. miles. Ottawa: Department of the Interior, 1907. *Presented by the Department of the Interior, Ottawa.*

This is a useful outline map giving, by means of the symbols and colours in which the lines are laid down, and by tables of distances, complete information concerning the railways and railway systems of the Dominion up to date. Among the latter is a table showing the lengths of lines constructed in 1906, and in another the lengths of all the lines in the present year are given.

Canada.

Dept. of the Interior, Ottawa.

Maps showing the electoral divisions in Southern Saskatchewan and Southern Alberta. Scale 1 : 792,000 or 1 inch to 12.5 stat. miles. Ottawa: Department of the Interior, 1907. *Presented by the Department of the Interior, Ottawa.*

These maps show the Dominion Electoral Divisions, according to the Representation Act of 1906.

Canada.

Dept. of the Interior, Ottawa.

Map of Manitoba, Saskatchewan, and Alberta. Scale 1 : 792,000 or 1 inch to 12.5 stat. miles. 3 sheets. Ottawa: Department of the Interior, [1907]. *Presented by the Department of the Interior, Ottawa.*

GENERAL.

World.

Frech.

Tektonische und seismologische Uebersichtskarte der Erde. Von Prof. Dr. Fritz Frech. *Petermanns Mitteilungen*, Jahrgang 1907, Tafel 19. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

These two maps accompany Prof. Fr. Frech's paper, "Erdbeben und Gebirgsbau," in *Petermanns Mitteilungen* for November last.

World.

Harmsworth.

Harmsworth Atlas and Gazetteer. Parts 28 and 29. London: The Amalgamated Press, Limited, 1907. *Price 7d. each part.*

These parts contain the following maps:—Part 28: Nos. 71-72, East Hungary, Galicia, and the Austrian Tyrol; 167-168, United States (general map); 205-206, Western Australia. Part 29: No. 75-76, Western Spain and Portugal; 123, Borneo, Sumatra and Java; 124, the Philippine Islands; 191-192, South America, Brazil.

World.

Hondius.

Hondius' World Map, 1611, by Jodocus Hondius. Edited by Edward Luther Stevenson, Ph.D., and Joseph Fischer, S.J. Facsimile issued under the joint

No. I.—JANUARY, 1908.]

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auspices of the American Geographical Society and the Hispanic Society of America, New York, 1907. *Price* £5 15s.

This map will be specially noticed.

World.

Rothaug and Zucalli.

Atlante Geografico ad uso delle Scuole cittadine, del J. G. Rothaug e M. Zucalli. Vienna: G. Freytag & Berndt, [1907]. *Price* 2.80 Cr. *Presented by the Publisher.*

A school atlas, principally consisting of maps of European countries, although a few small-scale general maps of other continents are added. On the larger-scale maps relief is effectively shown by a combination of vertical hachuring and colour tinting. The maps are clear, boldly drawn, and not overcrowded.

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published by the Hydrographic Department, Admiralty, during October, 1907. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.		
3607 m	= 3'0	Scotland, west coast:—Sound of Mull, eastern portion.	3s.
3669 m	= 6'0	Scotland, west coast:—Uig bay.	2s.
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2580 m	= 3'0	United States, east coast East river and northern approaches to New York.	3s.
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2254	Ireland, west coast:—Trillick bay to Liscaunor bay, including River Shannon. Plans of Tarbert road and Foynes island on this sheet	—	—
156	Sweden. Mäskur to Hällö, including approaches to Kingshamn.	New chart.	156
129	Sweden: Hono to Patermosters and approaches to Marstrand and Kladesholm	New chart.	129
678	North American lakes.—Lakes Erie and Huron. Plan of Port Huron on this sheet.	—	—
2376	Harbours in Formosa. Plan of Suao bay on this sheet	Plan of So O wan (Suao bay) on new chart.	3658
2407	Plans in Russian Tartary:—Tumen Ula.	—	—
128	Japan —Channels between Bingo Nada and Ozuchi jima.	New chart.	128
		Channels between Bingo Nada and Ozuchi jima.	

Charts that have received Important Corrections.

No. 2472, Scotland, west coast:—Loch Gilp, East loch Tarbert, Millport. 2639, Scotland, west coast:—Loch Carron and Loch Kishorn. 109, England, east coast:—Entrance to the river Humber, Grimaby road. 196, Sweden:—Nidingen to Höno. 2158a, Mediterranean sea, western sheet. 2158b, Mediterranean sea, eastern sheet. 2516, Gulf of St. Lawrence and the river to Quebec. 472, Harbours and anchorages of Haïti or San Domingo. 2820, Gulf of Mexico:—Entrance to Pensacola bay. 627, Africa, west coast:—St. Paul de Loanda to Great Fish bay. 748a, Indian ocean, southern portion. 748b, Indian ocean, northern portion. 40, India, west coast:—Karachi harbour. 838, Bay of Bengal.—Rangoon river and approaches. 776, China sea: Shiang Mun to Tra ko island. 854, China, east coast:—Port Swatau. 2400, China, east coast.—The bar and approaches to the river Min. 3585, China, north-east coast:—Approaches to the Wusung river. 3025, China, north-coast:—Wei hai wei anchorage. 452 Japan:—Yezo island with adjacent straits. 214, Solomon islands
(*J. D. Potter, Agent*)

Danish Charts.

K. Danske Søkort-Arkiv.

Danish Hydrographic Charts, Nos 55, Island og Færøerne; 150, Nordsoen, Horns Rev; 160, Vestlige del af Østersøen til 16° 30' Ø Længde, samt sundet og Belterne; 167, Graadby; 215, Odense-Fjord; 217, Islands Nordkyst, Steingrimsfjördr; 218, Dansk Vestindien, St. Thomas Havn. Copenhagen: Kongelige Danske Søkort-Arkiv, 1906-07. *Presented by the Danish Admiralty.*

Indian Ocean and Red Sea.

Meteorological Office.

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, December, 1907. London: Meteorological Office, 1907. *Price 6d. each. Presented by the Meteorological Office*

North Atlantic.

U.S. Hydrographic Office.

Pilot chart of the North Atlantic Ocean, November, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

North Atlantic and Mediterranean.

Meteorological Office.

Monthly meteorological charts of the North Atlantic and Mediterranean, December, 1907. London: Meteorological Office, 1907. *Price 6d. each. Presented by the Meteorological Office.*

North Pacific.

U.S. Hydrographic Office.

Pilot chart of the North Pacific Ocean, December, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Asiatic Turkey and Persia

Lorraine.

Fifty-seven photographs of Asiatic Turkey and Persia, taken by Percy L. Lorraine, Esq., of the British Legation, Tehran, 1907. *Presented by Percy L. Lorraine, Esq.*

Taken during a journey made in March, April, and May of the present year, from Constantinople to Tehran *via* Beirut, Damascus, Aleppo, thence overland to the Reskéné on the Euphrates, and down that river to Basra. From Basra Mr. Lorraine travelled through Persia to Isfahan *via* Ahwaz, and thence north to Tehran. Parts of the route are little visited by Europeans, hence the photographs have a special value.

(1) Camel caravan at Mersina; (2) Custom house, Mersina; (3) North Lebanon and Mount Sunnin from the railway; (4 and 7) Damascus; (5) Example of Arab architecture in the citadel of Aleppo; (6) The citadel gateway, Aleppo; (8 and 9) Aleppo; (10) The banks of the Euphrates at Meskene; (11) On board the *Shakhtour*; (12) Arabs watering their herds in the Euphrates; (13) *Shakhtour* at Anah, on the Euphrates; (14) An island in the Euphrates near Anah; (15) The Euphrates at Anah; (16) Mid-day halt on the road between Felludja and Baghdad; (17) Pontoon bridge on the Tigris; (18 and 19) Kut-el-Amara; (20) A "guffa" at Kut-el-Amara; (21) Arab boys diving at Amara; (22) Amara; (23) Quay at Amara; (24) Native sailing craft on the Tigris; (25) Ezra's tomb; (26) Junction of the Euphrates and Tigris at Gurneh (Korna); (27) Shatt-el-Arab; (28) A "bellum" on the Shatt-el-Arab; (29-34) Basra creek; (35) Two steamers belonging to Sheikh Khazzal on the Karun river near Bander Naseri (Ahwaz); (36) The Euphrates and Tigris Steam Navigation Company's S.S. *Malamir* at Bander Naseri; (37) On the Bakhtiari road near Jaru; (38) On the Bakhtiari road near Cheshin-i-roghan; (39 and 40) Ala Khorsid; (41-43) Camp of Shahab es Saltaneh, Malamir; (44) Bakhtiari tribesmen; (45) Between Malamir and

Tul-i-Shalu; (46) The Karun gorge at the Shalu bridge; (47) The Shalu bridge; (48) Between Sarkhun and Dopulan; (49) Bridge over Karun near Dopulan; (50) House of Shahab es Saltaneh at Ardal; (51) Ardal; (52) View from the entrance of the Tang-i-Daykesh Warkesh gorge; (53-55) Tang-i-Darkesh Warkesh; (56) The Zendeh Rud near Bistagun; (57) Isafahan-Tehran road near Isafahan.

China.

Davies.

Fifty-six photographs of Southern Chiang-su and Northern Ché-chiang, China, taken by Major H. R. Davies, 52nd Oxfordshire Light Infantry. *Presented by Major H. R. Davies.*

These photographs represent in a striking manner the characteristic scenery of the Yang-tzu delta, as well as the mode of life and industries of the inhabitants. Some of the views are panoramas.

(1 and 2) Wooden bridge; (3) Stone arch bridge; (4 and 5) Stone arch bridge, Grand canal; (6) Three-arch stone bridge; (7) European house-boat; (8-10) Chinese house-boats; (11) Ferry-boat; (12 and 14) Small cargo boats. (13 and 15) Big cargo boats, Grand canal; (16) Wheelbarrow near Shanghai; (17) Wheelbarrow loaded with cotton; (18) Cormorant fishers; (19) Machine for drawing up water for irrigation, worked by a buffalo; (20) Shed of irrigating machine; (21) Cormorant fishers at work; (22) Broken bridge; (23) A typical village; (21) Pagoda at Ping-wu; (25) A typical big creek; (26) Typical scenery; (27) A village; (28) Fishing-nets; (29) Naik Vishnu Gaohe, surveying; (30) Sifting corn; (31-38) Village men and boys; (39-45) Village women and children; (46-49) Typical scenery; (50) The "Hills" 20 miles west of Shanghai; (51) A typical big creek. (52) A typical village; (53) Bridge over Grand canal near Za-mén; (54) Northern part of Ping-wu; (55) Eastern suburb of Ping-wu; (56) Ka-hsing Fu from outside west gate.

New Zealand.

Martin.

Six photographs of the Great Tarawera Volcanic Rift, New Zealand, taken by J. Martin, Auckland, New Zealand. *Presented by Dr. J. Mackintosh Bell, M.A.*

(1) Mount Tarawera after eruption; (2 and 3) The White Terrace, (4) White Terrace eruption; (5 and 6) The Pink terrace.

New Zealand.

New Zealand Government.

Forty-one photographs of the Southern Alps of New Zealand, taken by the New Zealand Government Tourist Department. *Presented by Dr. Mackintosh Bell, M.A.*

A beautiful series of photographs, recently exhibited by Dr Mackintosh Bell at a meeting of the Society on the occasion of the reading of his paper. Some of the glacier and snow views are very good.

(1) Mount Cook from Mueller moraine; (2) Mount Cook and St. David's Dome; (3) Mount Sefton; (4) Mount Sefton from Hermitage; (5) Mount Sefton in storm clouds; (6) The Footstool from Seeley range; (7) Entrance of Hooker valley; (8) Mount Cook and the Hooker river; (9) Looking up Hooker valley to La Perouse and Baker's Saddle; (10) Ball hut from lateral moraine. (11) Mount Malte Brun from Constance glacier; (12) Malte Brun range from Ball pass, (13 and 14) De la Bèche and Minaret peaks, with Ranfurly and Constance glaciers; (15 and 16) Looking down Tasman glacier; (17) Looking up Tasman glacier from Ball pass; (18) Looking down Tasman glacier from Malte Brun; (19) On Tasman glacier, ice-ridges; (20-22) Head of Tasman glacier; (23) Mounts Tasman and Silverhorn; (24) Sunset, upper Tasman glacier; (25) Copland range and Lyttel glacier, (26) Top of Copland pass; (27) Looking across Welcome Flat and Copland river (28 and 29) In Copland valley; (30) Junction of Copland river and Architect creek; (31) The Footstool, Moorehouse range, and Copland pass, (32) Looking up Copland valley, Ryan's peak; (33) Mount Glorious, Copland valley; (34) Hochstetter ice-falls. (35) Amongst broken ice, Hochstetter ice-falls; (36) Ice valley, Hochstetter ice-falls; (37) Minaret and de la Bèche from Hochstetter ice-falls; (38) Ice cave, Hochstetter ice-falls; (39) Mount Cook; (40) Mount Cook lillies; (41) From Fairy cove, Manapouri.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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Vol. XXXI.

THE GORGE AND BASIN OF THE ZAMBEZI BELOW THE VICTORIA FALLS, RHODESIA.

By G. W. LAMPLUGH, F.R.S., F.G.S.

Introduction.—At the request of the Council of the British Association, I spent a few weeks in the summer of 1905 in examining the geological and physiographical features of the little-known country lying to the eastward and south-eastward of the Victoria Falls of the Zambezi river. My preliminary report on this investigation was read at the Johannesburg meeting of the Association in that year, and was subsequently printed.* More recently, I have dealt with the geological results in a paper published by the Geological Society of London;† and I have described the occurrence of stone implements, possibly of high antiquity, in this part of the Zambezi valley in another paper, contributed to the Anthropological Institute.‡

There still remains some geographical material that seems worth placing on record, though it is admittedly imperfect of its kind.

The primary object of my exploration was geological, and to this consideration all others were subordinate. During the necessarily rapid traverses, no time was found for strictly geographical work; and as the character of the country is such as to render accurate mapping peculiarly tedious and difficult, I had to abandon the idea of producing

* Abridged, in *Nature* for November 30, 1905 (vol. 73, pp. 111-114); and, fully, in *Rep. British Assoc. for 1905*, pp. 292-301 (London: 1906).

† *Quart. Journ. Geol. Soc.*, vol. 73 (1907), pp. 162-219, with map, and 7 plates from photographs.

‡ *Journ. Anthropol. Inst.*, vol. 36 (1906), pp. 159-169, with illustrations.

anything beyond a rough sketch-map.* It had been hoped that separate expert assistance might be obtained for the topographical work of the expedition, but this was not available in the event. Consequently, I can hardly do more than indicate where the representation of the country on the existing maps is incomplete or erroneous. In cartography, as in most matters, it is, indeed, much easier to criticize than to construct; and we shall probably have long to wait for a map of the region that will be accurate in detail.

My sketch-map here reproduced (Fig. 1) shows the routes that were traversed, and the approximate position of most of the localities mentioned in the following notes. As the method and circumstances of the traverses have been elsewhere described,† this information will not be repeated. It will be advisable, however, briefly to recapitulate the ruling factors in the physiography and geology of the region before describing the present aspect of its surface.

The country to be dealt with is a small portion of the vast South African plateau which has been deeply notched by the erosive activity of the Zambezi and its feeders in their rapid descent towards the Indian ocean. North-west of the Deka river the whole area within the sketch-map is underlain by a series of basaltic lava-flows, known as the "Batoka Basalts," which are probably of Mesozoic age. The course of the Deka river coincides approximately with the line of a great fault—the "Deka fault"—which brings in older rocks abruptly on its south-eastern side. These rocks consist of sandstones and shales with coal-seams which I have named "the Wankie series." On the south-east side of the Wankie coalfield, this series is seen to rest unconformably upon the oldest rocks of the country, a very ancient metamorphic and igneous complex. Where the plateau is still unbroken, these "solid" formations are generally overlain by superficial deposits of sand, "surface-quartzite," and other kindred materials, which are of much interest because of the evidence they afford for great changes of climate during comparatively recent periods.

Previous Exploration.—The course of the Zambezi river from its mouth up to the confluence of its tributary the Deka has been frequently traced;‡ and it has twice been followed up from the Victoria Falls to one of its main sources.§ But the routes described in published travels

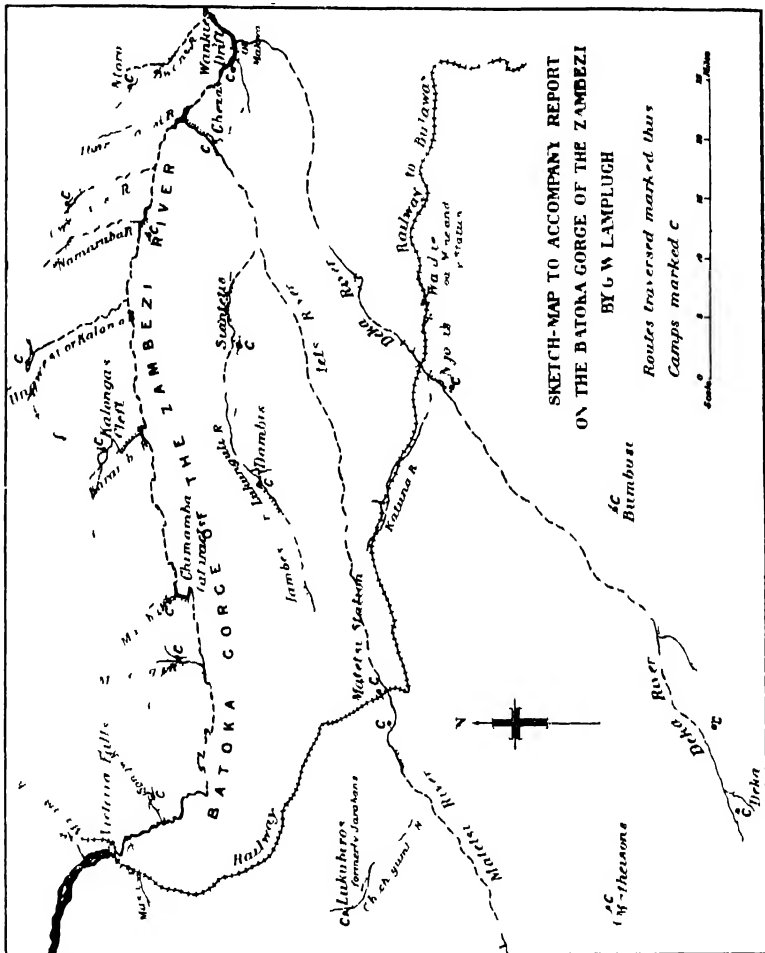
* I have traced out my route in manuscript, by compass bearings and dead reckoning, to the scale of 1 inch = 1 mile; but the result is unsatisfactory, from want of points fixed with precision.

† *Rep. British Assoc. for 1905*, pp. 292-296.

‡ The most systematic geographical exploration of recent date is that of Major A. St. H. Gibbons and his companions in 1898-1900, described by Major Gibbons in 'Africa from South to North, through Barotseland' (London: 1904).

§ By Major Gibbons (*supra cit.*), and by Colonel Colin Harding ('In Remotest Barotseland.' London: 1905).

have all swung away from the river, either to northward or southward, for the space of about 70 miles, between the Deka confluence and the Falls. For about 55 miles of this distance, measured directly, the Zambezi speeds tortuously in a rock-bound cañon through an excessively rugged wilderness, vigorously described by one traveller who entered its

**Fig 1**

southern fringe, as "about the roughest country in the world." * Much has been written respecting the anomalous zigzags at the head of this cañon, immediately below the Victoria Falls; but, owing to the difficulty

* F C Selous, in 'A Hunter's Wanderings in Africa' (London: 1890), p 103 See also further description on p 107.

of access, very little information has been forthcoming with respect to any other part of it. David Livingstone, in his second journey from the Falls, in 1860, gained a glimpse of it in two places from the north bank; * and in 1870, Edward Mohr reached its brink from the south at a vaguely indicated spot somewhere between the Matetsi river and the Falls.†

It was not until 1902 that the first steps were taken towards a systematic investigation of the "Batoka Gorge" (the name that seems most fitting for the cañon). In that year Mr. F. W. Sykes, who until recently held office under the British South Africa Company as District Commissioner and Conservator at Victoria Falls, traced the gorge continuously eastward as far as the Tshimamba cataracts, and also, with much difficulty, reached it at two or three points between these cataracts and the confluence of the Karamba river, which lies some 35 miles east of the Victoria Falls. The report in which Mr. Sykes described his investigation has not been published; but by the courtesy of the Directors of the British South Africa Company, I was provided with a copy of it before starting on my journey, and by their further courtesy I am permitted to quote passages from it in the descriptions which follow.

It was to my inestimable advantage that I was granted the personal guidance and companionship of Mr. Sykes in my own investigation of the country bordering the gorge on its northern side; and I was similarly aided in my later traverses of the country south of the Zambezi by the local knowledge and leadership of the late Mr. H. F. Greer, who at that time held the post of Assistant Native Commissioner at Matetsi.

The singular character of the cañon immediately below the Victoria Falls lent support to the original idea of David Livingstone that it was a veritable crack arising from a sudden rending of the earth's crust, and this idea has been reiterated by most of the travellers who followed him. It was pointed out, however, more than forty years ago, by Sir Archibald Geikie,‡ that the gorge had more probably been developed simply by the erosive force of the river itself; and this explanation was fully established by the evidence brought forward three years ago by Mr. A. J. C. Molyneux in the pages of this *Journal*§ as the result of his personal examination of the head of the gorge. Every part of the cañon that I visited bore out the conclusion that it is a valley of

* 'Narrative of an Expedition to the Zambesi and its Tributaries' (London: 1865), p. 308.

† 'To the Victoria Falls of the Zambesi' (Eng. transl. London: 1876), pp. 317-318.

‡ In the *first* edition of his 'Scenery of Scotland' (London: Macmillan, 1865), p. 33 and footnote.

§ "The Physical History of the Victoria Falls," *Geogr. Journ.*, vol. 25 (1905), pp. 40-55.



FIG. 2 The first reach of the Batoka Gorge below Victoria Falls
(before the railway bridge was built).
(*Photo by F. W. Sykes.*)

erosion; and I found excellent illustrations, elsewhere described,* of the mode in which the curious zigzags are developed, both in the main gorge and in its laterals, through the differential excavation that ensues where vertical planes of weakness traverse the rocks.

The General Aspect of the Gorge.—The Batoka gorge offers many attractions both as a spectacle and as a field for scientific research of various kinds. My own investigation included only so much of the cañon as sufficed to assure me of the continuity of its geological structure, together with the main outlines of its physical aspect.

The impressive perpendicularity of the walls in the upper reaches of the gorge seems, at first sight, to render access to its floor impossible except by artificial aid (see Fig. 2); but even in this part there are recesses which are in varying degree practicable for descent. Thus in the eastern angle of the chasm that forms the very beginning of the gorge, I managed, by slightly hazardous scrambling, amid heavy showers of spray, to reach the water's edge at the actual foot of the Victoria Falls; and the easy pathway down the Palm kloof, the next eastern angle of the cañon, is well known to all visitors. There is, again, not much difficulty in descending to the eastern side of the river at the little beach of white sand that lies within the acute bend south of the railway-bridge. Then follows a stretch of a few miles where the walls appear to be comparatively unbroken; but even in this portion it is probable that clefts practicable to the skilled climber will be found, for there is much intricacy of detail in the cliffs, in spite of the simplicity of their general contour.

As their distance from the Falls increases, the sides of the gorge become steadily less steep, owing to the more prolonged weathering which they have undergone, so that after the first 10 miles or so their aspect is no longer conspicuously formidable. They are, however, still dangerous, because broken at intervals by difficult "kranzes," or belts of crag, often deceptively foreshortened when viewed from above, and partly hidden by the growth of scrub on the slopes between them (Fig. 3). These crags mark the outcrop of the massive basalts, while the intervening bush-clad slopes conceal the bands of more perishable slaggy breccia which have formed the ancient surfaces of lava-streams.

But the main obstacle to the exploration of the middle and lower parts of the cañon lies in the difficulty of reaching its brink amid the maze of branching ravines gouged out by the tributary streams, whereby the country bordering the gorge is rendered untraversable. The Zambezi, in carving its low-level trench backward into the great plateau, has revived the erosive capacity of its tributaries one after another as the

* "The Geology of the Zambezi Basin around the Batoka Gorge," *Quart. Journ. Geol. Soc.*, vol. 63 (1907), pp. 187-192.

beginning of its gorge retreated past their mouths, so that always the mature system of drainage above this critical point has given place to a very vigorous "rejuvenated" system immediately below it. The

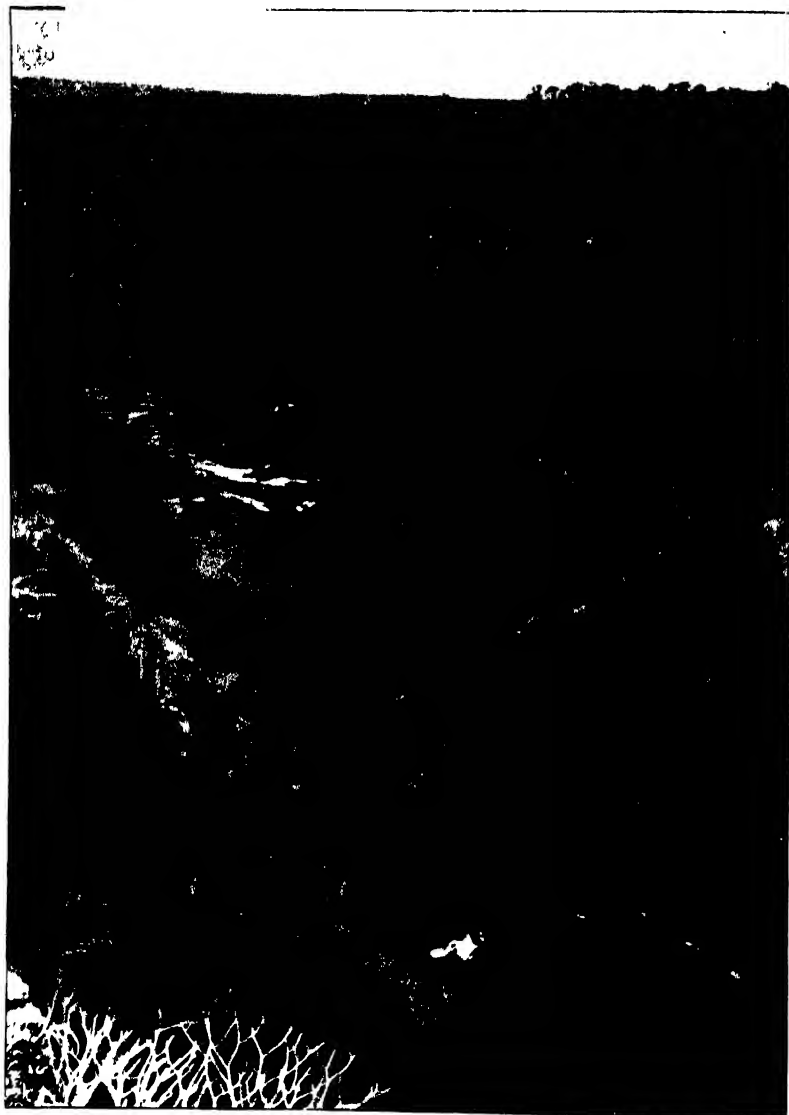


FIG. 3.—BATOKA GORGE, ABOUT 15 MILES EAST-SOUTH-EAST OF THE VICTORIA FALLS.

(Photo by F. W. Sykes.)

forcefulness of this rejuvenation is impressively demonstrated by the difference between the shallow valleys of the tributaries above the Victoria Falls and the gloomy chasms through which the feeders below the Falls gain confluence with the Zambezi. The length of these chasms is a rough measure of the time which has ensued since the main gorge was opened to their streams. Hence, the farther we descend from the present head of the Batoka gorge the longer and more numerous do the subsidiary ravines become, and the more thorough and intricate is the dissection of the plateau. At last hardly a vestige of the unbroken plain is left, and the country for some distance on both sides of the Zambezi is a bewildering network of craggy ravines and bush-clad ridges, parched and desolate during the dry season and lashed with torrents during the rains.

The depth of the Batoka gorge increases persistently eastward down to its termination a few miles above the confluence of the Matetsi river. The plateau itself falls steadily in the same direction, but the descent of the Zambezi within its trench is still more rapid. In fact, in the Victoria Falls the river has only well begun its active work, which it afterwards pursues relentlessly throughout the gorge; and the frequent occurrence of rapids, with at least one bold cataract, presently to be described, is sufficient evidence that the deepening of the cañon is still in progress. At the Victoria Falls the chasm, to mean water-level, is 360 feet deep; at the confluence of the Songwi stream, 6 miles below, the depth from the crest to the floor of the gorge, according to my measurement by aneroid, is about 460 feet; at the Chimamba cataracts, some 20 miles farther eastward, about 650 feet; and at the Karamba confluence (see map, p. 135) about 800 feet. The level of the Zambezi at Makwa,* near the mouth of the Deka river, appears to be about 1100 feet less than its level just under the Victoria Falls (see p. 135), so that the river, in passing through the Batoka gorge, loses in altitude thrice as much as it loses in its first plunge from the plateau.

The enormous augmentation of the Zambezi toward and just after the close of the wet season, while deepening the water considerably even on the broad upper river, has its greatest effect when the mile-wide stream is suddenly concentrated within the narrow confines of the gorge. In some spots we saw evidence of floods rising up to 50 feet above the dry-season level, besides covering the whole floor of the cañon in places where the channel of the river during the drought occupies only one-seventh of the total breadth of the floor. I have

* I have proposed that Major Gibbons' name "Makwa" be adopted for the place on the south bank of the Zambezi, a little above the Deka confluence, instead of the older name "Wankie's drift," in order to avoid confusion with the well-known place on the railway, some 35 miles distant (see *Quart. Journ. Geol. Soc.*, vol. 63, p. 167, footnote).

elsewhere discussed the potency of this extreme seasonal variation * in producing the peculiar features that characterize the cañon.

The broad platforms in the bottom of the cañon, dry during the low-water stages of the river, are of course directly due to this variation. It is difficult to realize the spaciousness of these platforms until one comes actually to traverse them, and then they seem indeed strangely disproportionate to the shrunken river.

It is, I think, from these platforms that one gains the most impressive views of the cañon, for they provide standpoints well away from the impending walls, and therefore giving open vistas. Not that the scenery of the gorge is possessed of much loveliness—usually it is stern, with a savage sternness. But there is that of strangeness in it, and of variety in detail grafted upon simplicity in outline, that grips the imagination.

However varied in foreground, the general features of the vista seen from the flood-platform is always the same: rugged ledges of black basalt underfoot, with the opaque green river pouring swiftly along its narrow channel in a string of eddying coils, and bursting tumultuously here and there into white rapids; along the outer borders of the flat, a broad fringe of glossy black boulders, with here and there a patch of glaring sand, marking the flood-limits of the river; behind the boulders, a narrow belt of trees in full dark-green foliage; and above, hemming in the view, the grim rusty-brown or purple krantzies and alternating slopes, clad at the dry season with faded scrub and trees, rising grandly up to the even edge of the plateau.

Where the river deigns to follow the direction of the main fracture-lines of the rock, the vista remains for a space remarkably straight and regular. But where the joints and other vertical fractures of the basalt lie athwart its course, the Zambezi swerves sharply to and fro in its struggle to cross the harder barriers, and the sides of the gorge are notched into zigzagging spurs that break down irregularly into sharp arrêtes and pinnacles, often so complex and overlapping from every view-point that the eye is baffled by their intricacy. In such places as, for example, just below the confluence of the Songwi (Fig. 4)—the river seems to plunge into a tangle of rock and disappear, and even from the crest of the gorge its doublings are hidden from view, so that patches of water gleam perplexingly from the depths in unexpected spots. The native report mentioned by Schulz and Hammar,† that the Zambezi in one place ran underneath the rocks, was perhaps based on some such apparent disappearance of the river.

It is in these sinuosities that the scenery of the gorge attains its greatest diversity and interest; and these portions also best deserve

* *Op. supra cit.*

† 'The New Africa,' etc. (London: 1897), p. 41.

detailed examination from the light which they throw upon the past conditions of the river.

In its minor features the flood-platform resembles the foreshore of a craggy sea-coast. Terraced reefs and irregular bosses of rock, sometimes high enough to form islands at flood-time, roughen its surface; and it is deeply pitted with well-like "pot-holes," ground smooth and true by the rock-drill of whirling torrent-driven stones. The amygdaloidal structure of the basalt is peculiarly favourable to the production of

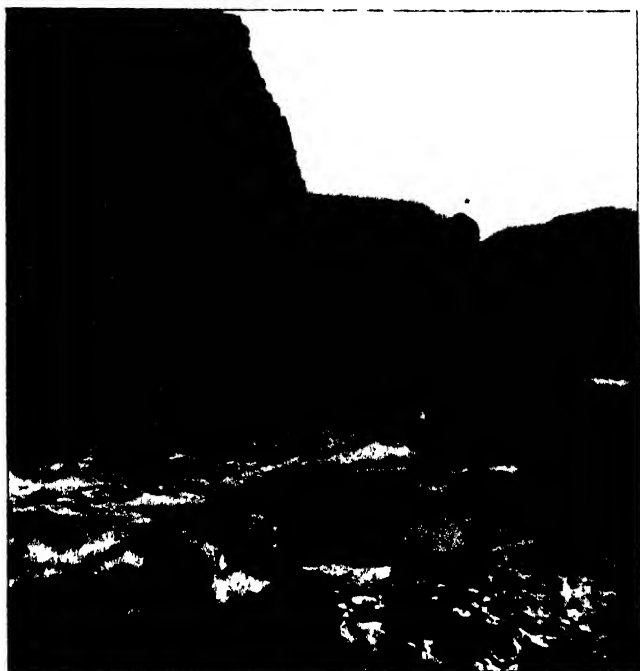


FIG. 4.—THE FLOOD-PLATFORM IN THE GORGE OFF THE MOUTH OF THE SONGWI, LOOKING SOUTH.

(Photo by Colonel F. W. Rhodes.)

these pits, which, by their numbers and size, are a striking characteristic of the floor of the gorge in many places. The more shapely are circular in plan, and I measured some that ranged up to 6 feet in diameter, and up to 12 feet in depth. At the time of our visit a few still held water, but most were dry, and sometimes contained a little sand among the round grinding-stones, along with delicate fresh-water shells which must have been either wafted in by the gentler current of the subsiding flood, or nurtured in the slowly evaporating waters of the pits after their last filling.

Besides these "pot-holes," the flood-platform occasionally holds broad deep pools, ranging up to the size of a small mountain tarn. Such pools occur in most cases at or near the mouths of the tributaries, and the hollows which they occupy have perhaps been initiated by the cataracts which originally descended from the "hanging valleys" of these tributaries, being subsequently maintained and deepened by the annual flood-scour. A pool of this kind at the great bend near the Songwi is shown in Fig. 5. At the time of our visit it was about 80 yards wide and 200 yards in length; a massive crag rose precipitously from it at one side to a height of 30 or 40 feet, while on the opposite side it was separated from the Zambezi by a low rock-barrier 60 yards wide, against which was banked a steeply sloping beach of white quartz-sand that, like most of the sand-patches of the gorge, gave out a sharp screech when trodden. The depth of its dark waters at the foot of the crag was certainly great, but we failed to obtain a sounding. The streamlet from the side gorge of the Songwi trickled into the pool through a broad fringe of flood-carried boulders, but was insufficient to balance the loss by evaporation, as progressive shrinkage was shown by the series of water-stains on the bordering rock. We saw at first numerous big fish and a crocodile in this pool, but they sank out of sight when we approached it, and the smooth gloom of its surface contrasted strangely with the wild energy of the great river that roared near by.

Sometimes at the mouth of a tributary the pool is replaced by a narrow water-filled inlet that runs across the flood-platform straight from the main river for some little distance up into the side gorge, as shown in the sketch-plan, Fig. 8. Along with certain other features of the cañon-floor, this is attributable to the fact that the Zambezi does not attain its high flood-level until toward the close of the rainy season, so that the earlier spates of its feeders in the Batoka country occur while the platform is still bare. Therefore, when a tributary happens to have struck along a plane of easy erosion, it sinks its trench clear across the platform to the low-water channel of the river. Later, when the Zambezi rises to its height, while its tributaries are already shrunken and feeble, the main flood surges up far into the mouths of the lateral chasms.*

I have no doubt that the animal and plant life that lies sheltered within the gorge and its branches would well repay systematic study, and I regretted my inability to deal with it. Always on descending into the cañon one was struck with the difference between the upper and the under world: the plateau, parched into seeming lifelessness by the long drought, enduring the full glare of the sun during the day and the

* This appears also to be the condition described by Chapman as existing at the confluence of the Gwai river ('Travels,' etc., vol. ii. p. 194). His description puzzled me greatly when I read it before visiting the gorge-country.

chill radiation of the night, its streams dry or merely trickling, and its vegetation sere and grey; the gorge, some hundreds of feet below, full of deep cool shadow in the daytime, and at night gaining warmth and shelter from its lofty barriers, its waters always plenteous, and its trees in full foliage.

Indeed we may look upon the cañon as an inlet of the low country reaching back into the plateau, and the investigation of its fauna and

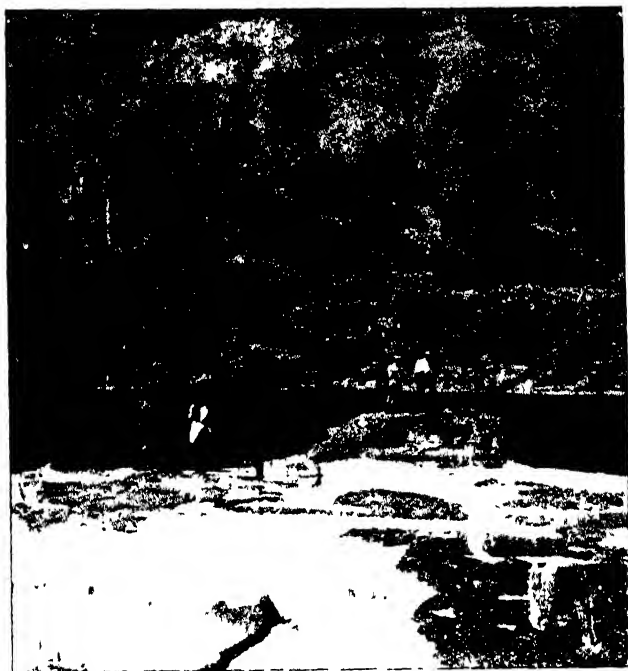


FIG. 5.—BIG POOL ON THE FLOOD-PLATFORM IN THE GORGE AT THE SONGWI CONFLUENCE.

(Photo by Colonel F. W. Rhodes.)

flora is likely to bring out this relationship. In its upper reaches we saw no traces of the larger mammals except the baboon, but to the eastward of the Chimamba cataracts the hippopotamus frequents the river, and antelope of various species enter the gorge, though apparently they are not numerous. In one spot only, opposite the mouth of the Namaruba river, we saw the spoor of lion on a patch of sand in the cañon.

The peculiar cloudy green colour of the river when viewed from the crest of the gorge, which has impressed most observers, is probably due to the presence of minute organisms nurtured in the placid reaches

above the Falls. It is not noticeable until the waters are concentrated within their deep channel below the Falls, and is most marked in the upper part of the cañon, becoming gradually less conspicuous in the lower reaches. We may therefore suppose that the colouring agent is partly eliminated by the swift current and aërating rapids of the gorge.

The great valley appears to lose its gorge-like character rather abruptly at a few miles above the confluence of the Matetsi river, and thereafter the Zambezi flows for several miles through a more open valley, bounded on both sides by comparatively low and irregular hills, which represent merely the stump of the much-dissected plateau. I was unable to reach the place where the change occurs, but on looking north-westward from the broad bar of rock and boulders that juts out into the Zambezi at the mouth of the Matetsi, I could see the broken edges of the high plateau converging upon the river from both sides within a few miles, while toward me they lost their definiteness and retired as a background to the undulating lower country bordering the river. At the spot some 10 miles farther up, where I reached the Zambezi from the south (see sketch-map, Fig. 1), it had not yet left its profound trench, that showed as a clean-cut notch in the plateau.

It is especially noteworthy that this change in the shape of the valley is not dependent upon a change in the character of the rocks, for the basalts are continuous right down to Makwa, the eastward limit of our journey. The lowering of the country near the river seems to be due, as will presently be shown, mainly to the erosive energy of several important tributaries, which, during the long interval since their low-level drainage was established, have carved out overlapping basins, and have left few remnants of the original plateau in the vicinity of the main river.

Suggested Reservation of the Batoka Gorge.—The excellent policy of the Governments of the United States and Canada in reserving tracts of natural grandeur or peculiarity from settlement or from proprietary rights of any kind, and in stringently protecting the wild life of such tracts, is now so well recognized and so widely adopted in our colonies, that it is needless to discuss its advantages. This policy has, I believe, been already applied by the Administrators of the British South Africa Company to the immediate surroundings of the Victoria Falls; and it should, in my opinion, be extended to cover the whole belt of country bordering the Batoka gorge and eastward up to the mouth of the Matetsi river.

The tract is not one in which minerals of economic value are likely to occur; the natives within its precincts are very few; its agricultural capabilities are slight compared with those of the vast adjacent areas that still await settlement; and its extreme ruggedness, while rendering

it unattractive to the sportsman, might long give shelter to the animals that inhabit it, especially to the hippopotamus. The increasing resort of tourists to the Victoria Falls opens the prospect that the gorge will before long be included in some "grand tour of the Zambezi," and it is therefore advisable that the country should be protected before private rights are acquired, as elsewhere has occurred, that might be difficult afterwards to annul.

I am fortunately able to add that, through the willing co-operation of Sir Lewis Michell, this suggestion has already been brought before the Directors of the British South Africa Company, with favourable result; and I am informed that steps are being taken to bring it to practical effect.

It would not need much labour to clear some rough tracks through this pathless country, by which, at any rate, the upper part of the gorge might be made quite easily accessible. The leisurely visitor might then find pleasure and interest in its wild scenery, which contrasts so sharply with the placid aspect of the country above the enchanting falls.

Description of Particular Portions of the Gorge.—From the shape of its walls, we may infer that all the upper portion of the gorge, for many miles, has been dug out nearly to its present depth by the descent of the Zambezi from the lip of the plateau either, as now, in a single grand plunge or in a succession of cataracts so closely connected as to have practically the effect of a single fall; and that the deepening which has since ensued, and is still in progress, has been of secondary consequence.

If the cañon had been excavated gradually, one should have found the successive stages indicated by ledges or terraces high above the present stream, whereas in the parts examined hardly any trace of old river-terraces was seen, the slopes, as shown in Figs. 3 and 7, being generally regular from crest to floor, except where the usual trap-like features have been developed in the basaltic lavas by subaerial weathering. The only place where a definite shelf was noticed within the cañon was between the acute elbows of the river just below the Chimamba cataracts (see left-hand side of Fig. 9). This shelf was inaccessible to me, but it appeared to lie 50 or 60 feet above the dry-season level of the Zambezi. I believe that it marks the prolongation of the thick bed of dense basalt across which the river now plunges at the lower Chimamba cataract, and that it is due to the recession of this powerful cascade.

Of the frequent splitting of the river into separate branches in its precipitous descent, just as it is now divided by the islands on the lip of the Victoria Falls, there are indications in several parts of the gorge. These conditions have prevailed wherever the river has crossed any belt in which vertical planes of structural weakness are numerous. Its waters in such places have simultaneously carved parallel or interlacing trenches along the several planes, until the more rapid recession of

some particular trench has again collected the river into a single channel.* Where this has occurred, the sides of the gorge are diversified by high pinnacles and ridges, separated from the main crest by deep precipitous notches and troughs which are the relics of the abandoned channels.

There is a readily accessible example of this subsidiary sculpturing in the zigzags below the Victoria Falls, only about a mile south-east of the hotel, at the end of the second spur on the western side of the river. This spot attracted the notice of several of the early travellers, and is described, and embellished, by Holub.† Here, the true brink of the cañon is rendered inaccessible for 500 or 600 yards by a steep-walled trench, 60 or 80 yards wide and 80 to 120 feet deep, which cuts off a narrow ridge along the rim of the main gorge, as shown in the birds'-eye view Fig. 6. The northern end of this ridge rises perpendicularly in a flat-topped kopje to the general level of the crest-line, but the remainder of it is irregularly broken by transverse gaps, and is terminated southward by a sharp swerve of the trench which then ends as a "hanging valley" in the walls of the cañon.

The peninsulas below the Songwi confluence 6 miles from the Victoria Falls show analogous features, softened and modified, however, by their much longer endurance of subaërial weathering.

It was at the mouth of the Songwi that we first descended into the gorge in our journey eastward. Mr. Sykes had previously explored this place, and gives, in his unpublished report, the following graphic description of the circumstances of his first visit:—

"With the exception of two old men, Namakabwi and Kalonga, the natives professed entire ignorance of all details necessary to assist one in viewing the gorge from consecutive points, so that it was only after constant checks and much labour that these were ultimately reached. . . . The Songwi is a lively little stream with deep pools, heading from the great open piece of country below Makoni's kraal. Following down its right bank along a well-defined track, and later on branching away still further to the right, the gorge is reached in about $2\frac{1}{2}$ miles. . . . The picture as presented from above [from the crest beyond the Songwi] is a striking one. Coming down a long straight reach with rapids showing up white here and there, the river enters into a perfect maze of intricate windings caused by promontories and buttresses of rock jutting outward from either bank, with island kopjes in the middle. One has to look more than once to discover what course the river actually follows. . . . With Namakabwi as guide, we descended by a zigzag path the towering face of the gorge wall [in a recess to the right of the Songwi confluence]. Huge masses of overhanging rock, seemingly on

* Cf. A. J. C. Molyneux, *Geogr. Journ.*, vol. 25 (1905), pp. 51-53.

† 'Seven Years in South Africa' (Engl. transl. London: 1881), vol. 2, p. 198.

the verge of toppling over, were passed during the descent. When about three parts of the way down, Namakabwi, the Old Man of the gorge, pointed out a cave partly hollowed out by nature and partly by hand. During a portion of the year when the water is low, he occupies this place, living on the different varieties of fish to be found in the still pools adjoining the main stream below. Descending into the gorge-bed, we clambered over huge basalt boulders worn by the action of the water to a glassy smoothness across patches of fine white sand,

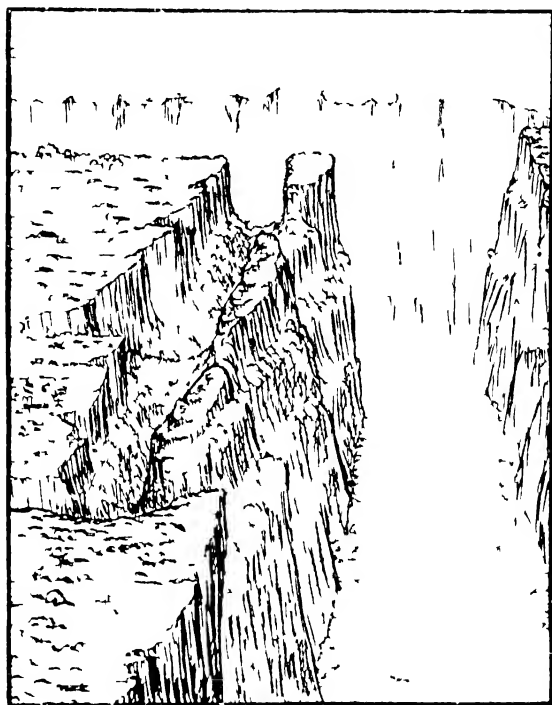


FIG. 6. BIRD'S EYE VIEW SHOWING AN ABANDONED CHANNEL ON THE CREST OF THE BAT KA GORGE 1 MILE SOUTH-EAST OF VICTORIA FALLS HOTEL

finally reaching the edge of the river. Here it comes rushing down at a great pace, swerving off at a tangent on meeting an opposing wall, thence, after swirling, eddying and boiling, in a couple of hundred yards it is forced backward in an opposite direction to its original course, and finally disappears round the corner of a perpendicular wall towering upwards nearly 500 feet. This locality was a favourite place of refuge in the old days."

The tarn-like pool on the flood-platform at this place has previously been described (p. 142). At the time of our visit, in July, we found the Zambezi pent within a dry-season channel that narrowed at one spot to a width of not more than 30 yards, while its flood-bed was fully six times this width.

From the bottom of the gorge we obtained access to the ravine of the Songwi, and pushed up its boulder-strewn bed, or through the dense wooded tangle that crowded the narrow space between its impending cliffs. But after about a mile, our progress was barred by a precipice which in the wet season must support a magnificent cascade, of about 80 feet, falling into a deep pool. The evaporating water of the stream had covered this precipice with a thick cushion of tufa, which was spongy with moisture and supported a rich growth of moss and fern, the brightness of whose verdure was enhanced by the sombre hues of the shadowed pool below and of the basalt cliffs above. On our way, we had found the remains of a young crocodile, a couple of feet in length, whose broad head was firmly wedged between two rounded boulders on which it had lost its grip in crawling up the gully; and the forbidding pool under the green-curtained cliffs looked a fitting shelter-place and nursery for such reptiles.

During his previous journey, Mr. Sykes had worked along the edge of the gorge east of the Songwi, but had found his progress impeded by numerous deep ravines. In his report he mentions that "at Chisoni [near the mouth of a tributary of that name] the gorge-walls shelve downward less abruptly than formerly, in places rendering access to the river from above comparatively easy;" and that "between Chisoni and Mavangu, the river becomes exasperating to follow owing to its sharp curves and generally sinuous course, and the exceptionally rough country to be traversed." From the different arrangement of the tributary-drainage on the southern side of the river, to be presently described, I am inclined to think that a somewhat less arduous route would be found if the gorge were attacked from that side.

We swung away northward to avoid this broken ground, and bore back to the crest of the cañon again at the mouth of a short impermanent stream, the Mavangu, about 11 miles east-south-east of the Songwi. Here, at a place called Syakowi by the natives, the river holds a straight eastward course for about $\frac{3}{4}$ mile, beyond which, in both directions, it curves sharply out of sight. The gorge, as shown in the photograph, Fig. 7, is remarkably trench-like and regular, with an even sky-line of plateau beyond. Its width from crest to crest, if my measurement with a range-finder be trustworthy, is approximately 400 yards.

On leaving the Mavangu, we again swung round the dissected country and intercepted the Zambezi next at the Chimanba cataracts, about 8 miles farther eastward. At this point the river, after having described an irregularly angular loop to the southward in its general

easterly course, is making back to the north. Mr. Sykes had previously seen something of the intervening country, having camped on a small stream called Kasya near the gorge, about halfway between Syakowa

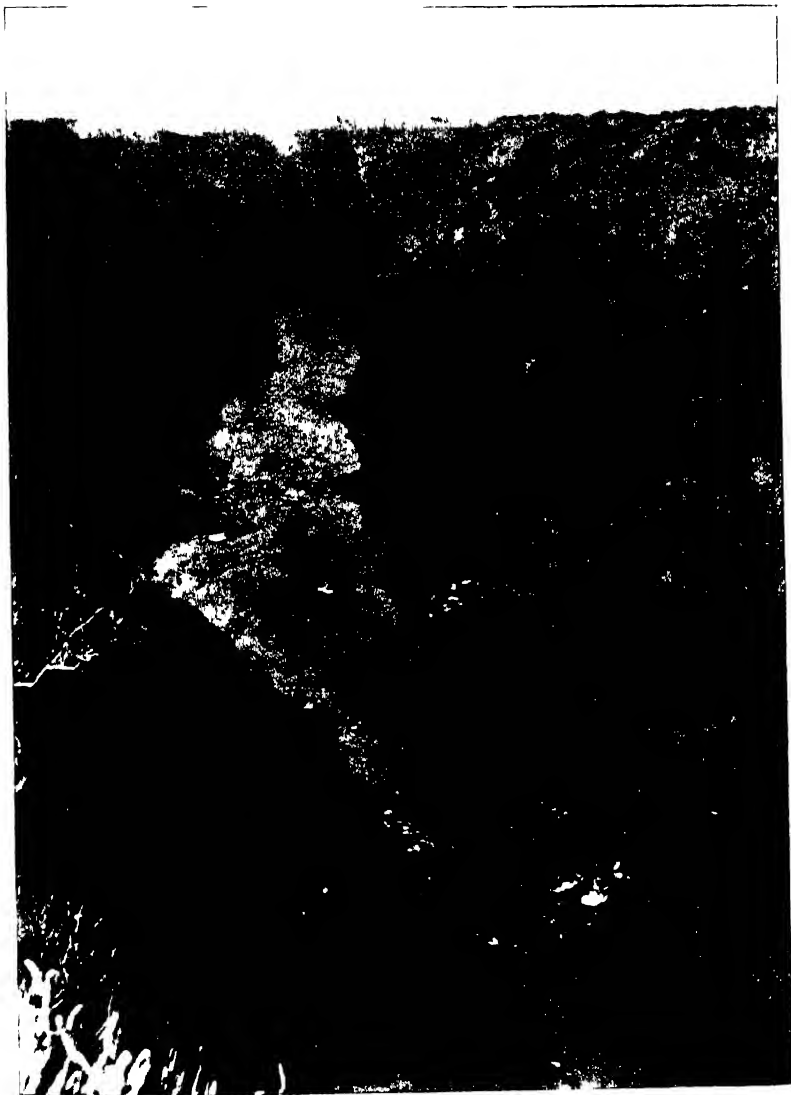


FIG. 7. BATOLA GORGE NEAR THE CONFLUENCE OF THE MAFANJE
RIVER INTO THE ZIMBABWE RIVER.

and Chimamba,* and he writes, "From Kasya to Chimamba is about 8 miles. In between are the Sililevu rapids and a section of very broken country, so that only a glimpse of the river in its serpentine course can be obtained here and there."

Chimamba is the more easterly of the two spots previously mentioned as having been visited by Livingstone in 1860. He diverged from his homeward route along the northern plateau on the native report of a waterfall in the gorge called "Moomba, or Moamba," the description of which "seemed to promise something grand." But, with the memory of the Victoria Falls fresh in mind, he was disappointed:—"When we

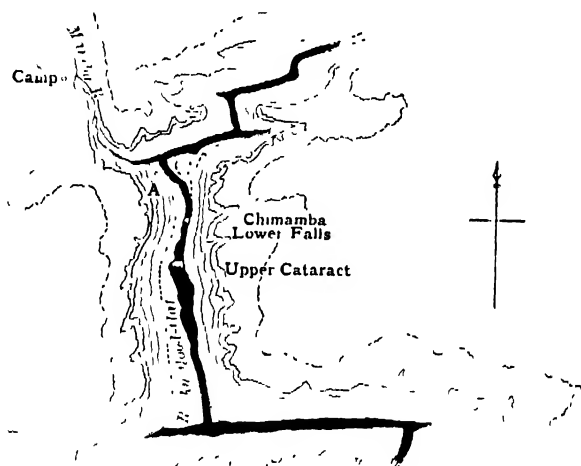


FIG. 8.—SKETCH-PLAN OF THE BATOKA GORGE AT THE CHIMAMBA CATARACTS.

The water-area at the dry season is shown in black.

looked down into the cleft in which the dark-green narrow river still rolls, we saw, about 800 or 1000 feet [about 650 feet, see p. 139] below us, what, after Mosi-oa-tunya, seemed two insignificant cataracts."†

Insignificant in height, it is true; but when one stands on the brink of the lower cataract and sees the whole volume of the great Zambezi converging into a single pass only 50 or 60 feet in width, shuddering, and then plunging for 20 feet in a massive curve that seems in its

* This word has been transliterated *Chimamba* in accordance with the rules of the R.G.S. The author, following the custom prevalent in the country, wrote of *Tshimamba* in his previous papers. The same alteration has been made in the names *Tshisonai*, *Tshishigamba*, etc., which appear later in the paper. The *s* has also been changed to *z* in *Zambesi*, *Gwemansi*, etc.

† 'Narrative of an Expedition to the Zambezi,' etc., p. 308.

impact visibly to tear the grim basaltic rocks asunder, one learns better than from the feathery spray-fans of the Victoria Falls what force there is in the river, and one wonders no longer at the profundity of the gorge!

I will quote Mr. Sykes's description of the surroundings. "The Chimamba rapids are situated just above the junction of the Mamba river with the Zambezi. This stream, when running, flows from a north-westerly direction through a steep gorge into the main channel. From the point of the promontory formed by the Mamba inlet and the main river a commanding view opens up, embracing the sluggish waters above the rapids, then the rapids and cataract, and toward the east a long reach with islets and broken water, terminating in the inevitable corner (see sketch-plan, Fig. 8,* and panoramic view, Fig. 9).

"Descending into

* Reproduced from *Quart. Journ. Geol. Soc., supra cit.*, p 189.



FIG. 9.—PANORAMIC VIEW OF THE BATOKA GORGE AT THE CHIMAMBA CATARACTS.

(Photo by F. W. Sykes.)

The outlook ranges from north (left-hand) by east (centre), to south (right-hand). The position of the view-point is marked A in Fig. 8. The white patches above water-level in the gorge are tracts of dry sand.

the main gorge from the south side of the promontory, a steep and arduous climb brings one down to the upper portion of the gorge-bed of smooth shiny boulders, which at high water is covered with the flood. On in front the river, after tumbling over a succession of rapids, is turned off at a sharp angle towards a narrow gut not more than 25 yards in width, through which it spouts with terrific force into a semicircular basin (Fig. 10).

"After the Falls, it is, perhaps, somewhat a misnomer to dignify the Chimamba cataract by calling it a "fall," though there is certainly an abrupt drop of about 20 feet, and a miniature spray-cloud, with a rainbow, floats over the basin into which the water is hurled.

"The outlet from this basin is nearly at a right angle to the fall. When it is remembered that the whole of the wide Zambezi is compressed into this incredibly small area, and that a fall and two sharp angles add their influence to the pent-up force of the waters, some idea may be gathered of the swirl and fury concentrated within the low confining walls of vertical rock. Standing near by, one can feel a perceptible vibration beneath one's feet, as the surge every now and then exhibits a spasm of extra violence."

(To be continued.)

NOTES ON A JOURNEY FROM BANDAR ABBAS TO SHIRAZ VIA LAR, IN FEBRUARY AND MARCH, 1907.*

By Lieut. A. T. WILSON, 32nd Sikh Pioneers, I A.

SECTION I.

Bandar Abbas to Lar.

THAT portion of South Persia which lies between Bandar Abbas and Shiraz is so little known and has been described so scantily by travellers and geographers in the past, that the publication of the following notes on this region requires no justification. No scientific inquiry has ever touched this portion of Persia, and existing maps are conspicuously inaccurate. The route described below is that *via* Lar and Jahrum. Although now only used for local traffic,† it was once one of the great trade routes of Persia, and the little Shah Abbas caravanserais all along the route testify to the importance attached by the greatest king that Persia has had in recent times to this road.‡

As regards Bandar Abbas, the starting-point of the journey, nothing need be added to the exhaustive account given in Curzon's 'Persia,' §

* Map, p. 244. Photographs by Lieut. A. H. P. Cruickshank, 32nd Sikh Pioneers, I A

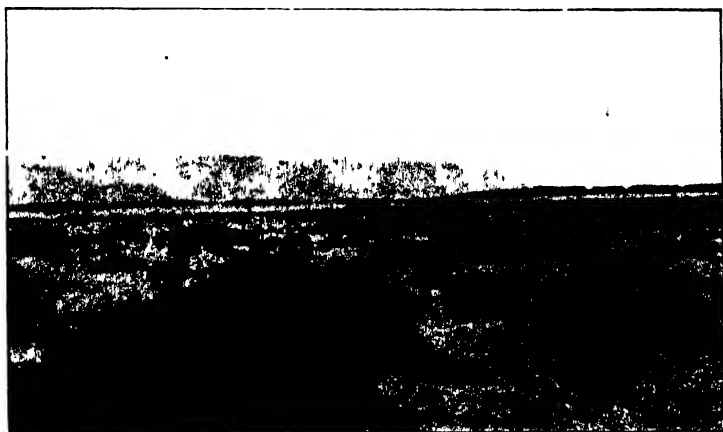
† Sykes, '10,000 Miles in Persia.'

‡ Curzon, 'Persia.'

§ Ibid

supplemented by some notes by Major Sykes which appeared in a recent number of this *Journal*. A new British consulate, planned on a scale worthy of the dual government which its occupant will represent, is rapidly approaching completion; it is built, by a strange irony, of stone extracted from the very foundations of the ancient city of Gombrun, on Hormuz Island, the focus of Portuguese activity in the Far East before the current of British commerce and conquest had set eastwards.

Leaving Bandar Abbas, the road to Lar runs along the coast in a westerly direction for some 15 miles, touching a few date groves here and there, and often crossing the dry beds of torrents which take their rise in the hills to the north. The "raised beach" formation, so con-



GACHIN PLAIN. KUH I-GINAO IN DISTANCE.

spicuous at Bandar Abbas, gradually disappears as one goes westward, and ends altogether about 15 miles west of Bandar Abbas. At the desolate serai of Chesterneh the road turns abruptly west through the Tang-i-Chakabak. A curious illusion was here produced by the salt efflorescence remaining in the dry bed of the torrent which runs through the pass: until within a few hundred yards, the white salt looked exactly like the foam of water, so naturally does it lie in the hundred channels occupied in flood-time by the water.

Traversing a desert valley bounded on north and south by low hills of grey marl, topped with Tertiary gravel beds of great hardness and at varying angles, the scattered village of Gachin is reached, surrounded by date groves. The boundary between Lar and Bandar Abbas districts runs through this village, a portion lying in each of those districts. Six miles to the north Kuh-i-Namak-i-Angaru rises steeply; it is a typical instance of the occurrence on the mainland of the "Hormuz formation

of igneous rock of a reddish colour, associated with rock-salt." * The latter, dissolved and deposited in the ravines that furrow the red slopes of the hill, has formed long scars of a brilliant whiteness, which makes the hill easily recognizable at first sight. This formation, although sufficiently uncommon to attract notice wherever seen, is not so rare as have been supposed. It occurs in the hills bounding the Aliabad plain to the south, 20 miles east of Lar, and also east of Biris and elsewhere.

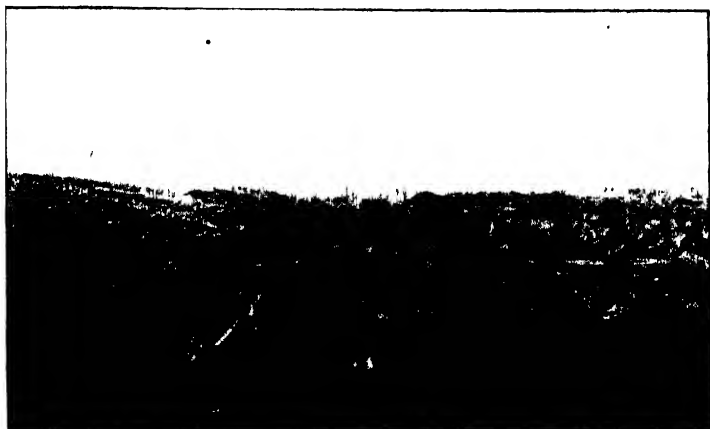
In colour the reddish shales contrast strongly with the sandy-browns of the surrounding hills, whilst in shape, this formation occurs in vast knolls on a circular base, in the middle of a hill composed of brown Tertiary gravels or sandstones, from below which latter it appears to have forced itself, overspreading on either side the edges of the cup thus formed. A similar formation is also found south of Gachin. Twelve miles east of Gachin the road crosses the Shor river by a treacherous ford. This river should be of peculiar interest to geographers. No two maps agree as to its course, which has yet to be explored. After an exceptionally dry season, it was 60 yards wide, and 2 feet 6 inches deep, in March, 1907, flowing at the rate of about 3 miles an hour. Such a flow presupposes a very large basin or catchment area, probably including mountains covered with snow in winter. The combined waters of the Hajamal river, the Rudari river, and the Birkeh Sultan valley produced only a quite insignificant flow of water. The total catchment area of these streams is certainly not less than 5000 square miles, hence we may reasonably assume that the area drained by the Shor river is immensely greater, and probably greater than that shown on the map. I may here add parenthetically that the existence of the Naband river, receiving water from Biris and Lar, is more than doubtful, whilst it is quite certain Kuh-Kunchi and Kuh-i-Pul-i-Khamir, south of Birkeh Sultan, are continuous, the tributary of the Maherun separating them being non-existent.

To return to our road, on the north bank of the river, about half a mile from the road, will be seen two bridges, each of about 40 arches, of stone and still almost intact. The river has long ago changed its bed, and left the bridges standing useless on the bank. Like almost all other public works of utility and beauty in Persia, these bridges are the work of Shah Abbas. The Khan of Lar has announced his intention of building a new bridge, which, if ever completed, will be a great boon to caravans using this route.

From Gachin to Kuristan the valley presents few features of interest. To the north it is bounded by the precipitous and impassable slopes of Kuh-i-Gishu, to the south by low barren ridges. No cultivation is to be found, and the valley is practically unpopulated except for a few weeks in the year, when the harvesting of the dates brings out crowds from Bandar Abbas.

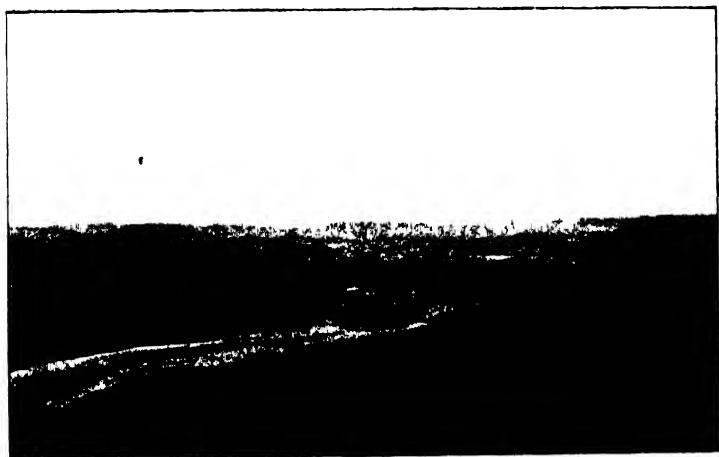
* See Goldsmid, 'South-East Persia,' vol. 2, note by Blanford.

At Kuristan the whole surface of the valley is covered with pebbles and small boulders, and furrowed by water, showing that when the Hajamal, coming through the Tang-i-Rasul, and the Rudari river,



VIEW FROM TANG-I-BUDABI, LOOKING NORTH-WEST.

coming through the Tang-i-Rudari, are in flood, the whole valley, here about 3 miles broad, is flooded. The orography of this region is



KIRSHI KUH-I-GISHU IN DISTANCE.

typical of that of Persia as a whole: the Rudari, waterless except when in flood, pierces a ridge of rock some 400 feet above plain-level (see illustration)—a ravine so narrow that, when in flood, the river is as

much as 30 feet deep at this point, restricted as it is by precipitous walls of very hard gravel conglomerate. The Tang-i-Rasul is somewhat similar in appearance on the south side of the valley. It should be noted that the above streams are not shown on existing maps as debouching at Kuristan.

On either side of the Kuristan valley, separated from it by steep rocky ridges, are desolate salt wildernesses, through which the above rivers run. For many hundreds of square miles the hard grey marl which underlies the Tertiary gravels in this part of the world has been laid bare.* Being soft, it has been worn by rain into numberless razor-edged hills or hillocks, with steep even sides, and the contrast between the light marl and the dark shadows in the early morning or in the evening is most striking.

This plain occupies, in reality, the wide expanse bounded by Kuh-i-Hormuz, Kuh-i-Zad Mahmud, Kuh-i-Howin, and Kuh-i-Goniz and Kuh-i-Gishu, which form three sides of a trapezium, and enclose an area drained by the Rudari river into the Kuristan valley. A road leads through Tang-i-Rudari to Rudar, Gishu, Howin, and Titang, and thence in all probability to Forg. It is to be hoped that some future traveller may explore this road, which would yield valuable geographical results.

From Kuristan to Birkeh Nuh the road, slowly ascending, traverses a barren narrow valley, uninhabited, and hedged in on either side by high ridges which separate it from even more desolate expanses. The caravanserai of Birkeh Nuh stands alone upon a stony little plateau, drained by three torrents, flowing respectively towards Kishu, Kuristan, and Jihun. Kishi itself is a little village at the foot of the broad-backed slopes of Kuh-i-Kishi; it is some 4 miles distance from Birkeh Nuh, and owes its existence to the fresh-water stream rising on Kuh-i-Hormuz, and flowing past Kishi into the Rudari torrent. It is noteworthy that whenever streams rise and flow on tertiary gravels, they remain fresh, but soon become brackish when they reach the grey marl, which is, I think, undoubtedly saline.

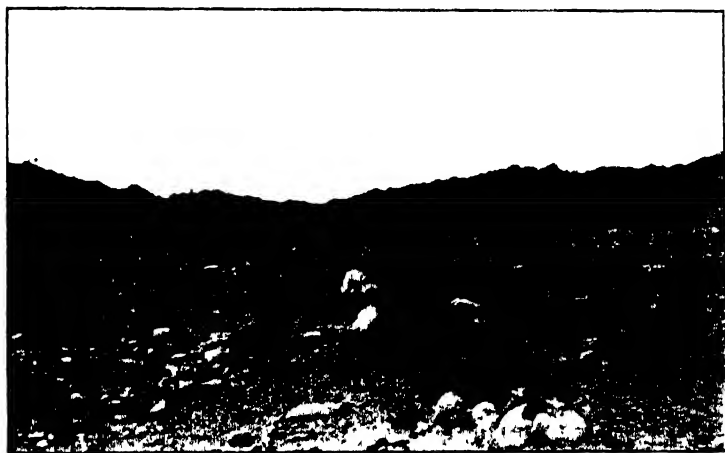
Leaving Birkeh Nuh, the road descends to the Jihun plain, the length of which it traverses. At Jihun a road diverges to Bastak, crossing the stream, here known as the Rasul river, but further up as the Hajamal river which joins the Rudari stream at Kuristan. Duck were here seen in fair numbers, although the stream was excessively salt. At its most westerly extremity stands the serai of Pas Par Dalan, at the entrance to the Tang-i-Dalan, dominated by a watch tower which commands the footpath connecting Dalan village with the serai. A splendid supply of water from a *kanat* and several palm trees combine to delight the traveller, who will have had to content himself for the

* Vide H. J. Carter, *Proc Bombay Asiatic Society*, 4, 1853, pp. 21-26.

past week with treeless camping-grounds and water of a most indifferent quality from the cisterns, so dirty as to defy all efforts to cleanse it with a Berkefeld filter.

The Tang-i-Dalan, which is now entered, is a narrow gorge through which the Hajamal river flows: on either side cliffs rise to a height of about 200 feet very steeply, whilst the river-bed occupies almost the whole of the bottom of the gorge. This formation continues for about 2 miles, until Sartang is reached, a picturesque little *serai*, with a date grove near by, standing at the foot of Kuh-i-Hormuz, which rears its bare head 1500 feet above the plain.

From Sartang to Hormuz the road winds among low hills, which fill the valley and obstruct the view to an unaccustomed extent, until the



PAS PAR DALAN.

little village of Hormuz, with its large date groves, comes into sight, standing on a grassy plain some 5 miles in either direction, and bounded on all sides by high hills.

Stack * reports the existence of extensive ruins near Hormuz; none such were seen on this occasion, nor are they mentioned by Vaughan; † and, in any case, their existence does not go far to prove the existence, in some by-gone period, of a large city. The Persian habit of deserting villages and houses, and of rebuilding houses, when necessary, upon new sites, is too well known to require mention in this connection.

The road now leaves the main caravan route to Yezd *viâ* Forg, and quits the valley *viâ* the Gardan-i-Bazan, a steep and slippery pass over

* E. Stack, 'Six Months in Persia,' 1882, vol. 1, pp. 147 *et seq.*

† *Proceedings* R.G.S., 1890, pp. 580 *et seq.*

slabs of inclined limestone, which cause no small difficulty to horses, though donkeys apparently negotiate it without difficulty. Limestone was here observed for the first time.

Once arrived at the summit, which is only some 400 feet above the Hormuz plain, a magnificent view is commanded of the Aliabad plain, which stretches for some 15 miles westwards, and is refreshingly green after the arid wastes previously encountered. Its sole denizens are a few nomads, with numerous flocks, and the timid inhabitants of the hamlet of Aliabad, who live in constant fear of the Arabs.

The Aliabad valley is in reality some 16 miles wide, but is bisected by the narrow Kuh-i-Fildani ridge, which is pierced in three places by streams flowing east to the Shor river. The southern half of the valley is grassy, and only salt in a few places; the northern half is a wilderness of water-worn hillocks of grey marl, and so encrusted with salt that not a blade of grass, nor, indeed, any vegetation whatever, can be seen. At the west end of the valley, the road adopts the more northerly fork of the valley, and, leaving Aliabad, some $1\frac{1}{2}$ miles to the north of the commodious *serai* of Chahar Birkoh, ascends gently over the usual stony wastes to the so-called Tang-i-Nao, an inconspicuous ridge, which divides the Lar and the Aliabad valley, and incidentally is the dividing-line between the basin of the Shor river and that of the river which drains the Lar plain. Everything points to this plain being drained into the Mand river, or into its tributary, the Kara Agach; the Naband river could nowhere be identified, nor could its existence be corroborated in any way. From Tang-i-Nao to Lar is a dreary march of 16 miles over a flat alluvial plain, bounded on either side by barren mountains. Such irrigation as is practised is effected by means of wells, *kanats* in actual use being few in numbers. When within 4 miles of Lar the first glimpse of the city is obtained, but it is not until the hills west of and dominating Lar are ascended that the full beauty of the city can be appreciated.

Standing at the foot of the flat ridges, which rise some 400 feet above plain-level and block the valley to the west, the city of Lar presents a not unimpressive spectacle. To the east the fertile plain, dotted with palm groves and clustered hamlets, stretches for some 10 miles; to the south, the road to Lingah winds up the rugged slopes of the mountains which lie between Lar and its principal port Lingah, whilst to the north a scarcely less forbidding range of hills seems to bar the way.

Stack has left on record a good account of the town, but twenty-five years have elapsed since he visited the place, and, alone perhaps amongst all the towns of Southern Persia, Lar has altered for the better during that period. The fine covered bazar, which Stack found in ruins, is now in excellent repair, and the home of busy and prosperous merchants, amongst whom are here, as elsewhere, a few Jews. The splendid cistern

that Stack saw in ruins is now restored, and full of excellent water; the fort, on the other hand, and the town walls are no longer recognizable.



TANG-I-DALAN.

The father of the present Khan is responsible for these and other public works of utility in Lar, and the excellent example thus set has been



SARTANG DATE GROVE. KUH-I-HORMUZ IN DISTANCE.

followed by his son, in spite of the treatment which he received at the hands of the Persian Government when he took his father's place as Khan. If we are to believe local tradition, the Government then

demanding 100,000 Tomans on the ground that a ruler who had built so extensively must assuredly have left great wealth behind him.

The present Khan is a fine specimen of a class that is, unhappily, extremely rare in Persia. His office is, in practice, hereditary; he enjoys the confidence of his subjects, and the respect, to put it mildly, of his superiors; in these respects he resembles his father.

Stack's description of the present Khan's father is so apposite as to deserve quotation: "A tall, powerfully built man, dignified and orthodox, seemly in person, decorous in apparel, stately in speech, courteous in demeanour; his dress half Arab."

SECTION II.

Lar to Shiraz.

The road to Shiraz from Lar *via* Jahrum leads over some steep ridges, past a serai known as Pusht-i-Sangar. Long lines of heaped-up stones in the vicinity suggest the derivation of the name; in all probability these defences are a relic of the Baluch raids stated by Sykes * to have taken place in 1810. Native tradition confirms this view. Once over the steep ridges that shut in the Lar valley to the north, and which are pierced only by the Gardan-i-Narangi, the road descends steeply to the Kurdah plain, and is here so blocked by overhanging rocks as to present serious difficulties to camels with bulky loads. Whatever water is not absorbed by the thirsty soil of the Kurdah plain runs in a small watercourse down the centre of the plain in a westerly direction. After a dreary march of some 8 miles across this plain, a sharp corner is turned, a small ravine followed, till the track emerges on to the little Dahkuh plain, an expanse of perfectly flat arable land some 2 miles square, hemmed in by low hills, and drained by the ravine referred to above into the Kurdah plain.

From Dahkuh a track diverges direct to Ferg, the main road to Jahrum running north-west over very stony ground for some 12 miles to Biris. Midway between Dahkuh and Biris the track crosses the watershed dividing the Kurdah and Biris systems. Existing maps are incorrect on this point.

The fine serai and little hamlet of Biris, with blue domed mosque close by, stands at the edge of a narrow flat plain, some 10 miles long east and west, and 2 miles broad. To the east, Kuh-i-Safid stands up prominently, the reddish-brown shales, relieved by white streaks of salt in the ravines, contrasting strongly with the uniform grey of the surrounding gravels. The plain is drained by a torrent which has forced its way northwards through successive ranges of hard

* Major P. M. Sykes, 'Ten Thousand Miles in Persia,' p. 105.

conglomerate, from 50 to 400 feet in height, and then, turning west, flows down a narrow ravine until it debouches on to the Banaru plain.

Surmounting the low ridge which bounds the Biris plain to the west, the road descends through ravines and gullies to a fertile little valley, remarkable for the rocky ridges which project from the flat plain; the appearance of such isolated ridges, from 20 to 200 feet in height, is uncommon in the plains, and the writer can recall no place in Persia where they are so prominent as in this valley.

Banaru is a picturesque little town, built on the precipitous slopes of Kuh-i-Banaru, which rears its gaunt frame to a height of nearly 1000 feet above plain-level. Its summit, known locally as Takht-i-Banaru, or the Throne of Banaru, commands a magnificent view of



PANORAMA OF LAR.

the surrounding country. It is crowned by the ruins of a building, apparently of great age; a covered way, of which the remains are visible, led thence down the eastern edge to the walled town below. Ruins of about a hundred houses, built on the steep and rocky hill slopes, with a large cistern, and a well sunk through the solid rock to a depth of 200 feet, the whole surrounded by a double wall of great thickness, indicate that the town was formerly, as local tradition asserts, the seat of a semi-independent government. At the foot of the hill high continuous mounds of earth mark the site of an old fort, probably contemporaneous with the town.

From Banaru an uninterrupted view is obtained across the plain which stretches 12 miles northwards to Juwun, a village some 3 miles from the south slope of Kuh-i-Alburd, and the centre of a scattered line of villages which extends east and west along the edge of the plain.

Juwun is the headquarters of a portion of the Lar district, and was, in March, 1907, in charge of Husain Ali Khán, son of Sheikh-ul-Nizam Khán and nephew of Ali Kuli Khan, the present ruler of Lar. In many respects he resembles his uncle; tall, handsome, and powerfully built, he appeared to be both intelligent and energetic, and deservedly popular with those whom he ruled. It need scarcely be added that, like his uncle, he evinced that courtesy and hospitality for which Persians are famous.

From Juwun to Jahrum the traveller must choose one of two possible routes. The most commonly used track, *riá* Chahtalkh, is stony, hilly, and liable, according to native report, to raids. The alternative route *riá* Chahtiz is of equal length, attains a higher elevation (5000 feet), has no intermediate serai, and for the first few miles presents difficulties more formidable than will be met with anywhere else between Bandar Abbas and Resht. It is the latter route that is described below.

After a gentle ascent of 3 miles from Juwun towards the foot of the hills, the road enters the Tang-i-Kulún. It here passes along the bed of a ravine, which transects the lower slopes of Kuh-i-Alburd in the same way that the Kara Agach transects Kuh-i-Safidar. The bed of the ravine, seldom more than 15 feet, sometimes only 5 feet wide, hedged in by impassable cliffs and blocked by large boulders, presents real difficulties to donkeys and mules, and cannot be negotiated by camels; during heavy rain the gorge is impassable. After traversing this gorge for about 3 miles, the path emerges by a steep ascent on to the Yezi-i-Khast plain, and, turning west-north-west, continues up the Chahtiz valley. This valley, hitherto untrodden by Europeans, and not marked on existing maps, is perhaps the most strikingly picturesque of all the valleys of South Persia.

It is uninhabited except by nomads, and, for a few months in the year, by a few families from Juwun or Jahrum. It receives the greater part of the drainage of the lofty Kuh-i-Alburd, and partly on this account, partly by reason of the elevation, is plentifully wooded with tall bushes and stunted trees, which lend a very un-Persian appearance to the valley. To the west, the valley is bounded by a precipitous isolated ridge about 1000 feet high, whose slopes on either side are of not less than 50°; this range is pierced in three places by gorges which carry off the water from the slopes of Kuh-i-Alburd into this valley, whence it drains towards Juyun or Jahrum as the case may be. The summit of the pass (5400 feet), known as Chahtiz,* or Chahbid,† is a grassy plateau, sparsely wooded, sheltered on east and west by high ridges half a mile distant, and furnished with a small spring.

* = steep well.

† = desert well or willow well. There is reason to believe that the latter derivation, though the popular one, is incorrect.

From this point to Jahrum the valley presents very similar features to those indicated above, the isolated ridge continuing to within 8 miles



ENTRANCE INTO TANGI TADUN AZIMUNGIRD IN DISTANCE

of Jahrum, where it is merged into the Kuh-i-Bafra, as the north end of Kuh-i-Albuid is called. Jahrum has been not infrequently



FOOTBRIDGE OVER KARA AGACH, NEAR ISMAILABAD

visited in past years, and it is not necessary to add anything to the accounts that have already been published. Suffice it to say that it is a flourishing town of some 9000 inhabitants, who live by agriculture, and on the proceeds of the famous date palms for which Jahrum is

famous throughout Persia, rivalling even Basra in this respect. It stands on a broad plain, well irrigated and cultivated, but broken in places by rocky ridges. Turning east and fording a salt river, called "Shur"* by the natives of the plain, for want of a more definite appellation, the track passes over a masonry bridge in good repair, which spans a permanently dry watercourse, probably the old bed of the river previously crossed. Three roads diverge at this point—one to Fasa, another to Shiraz *via* Khana Kahdan, and a third to Shiraz *via* Azimunjird.

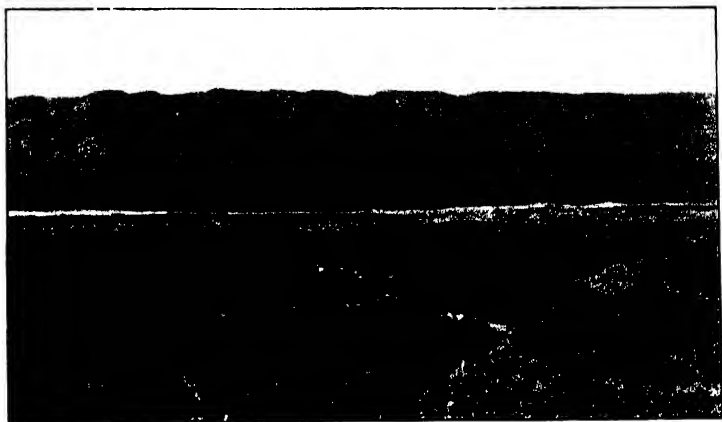
Following the last named, irrigated fields are traversed for another 4 miles, when the hills are again reached. The road now enters a new phase, running amongst low ridges and hillocks to Mukhak, a large *serai* standing alone 17 miles from Jahrum.† North of Mukhak, midway between this place and Azimunjird, the track crosses the watershed separating the Jahrum and Kara Agach valley systems, and descends gently to the south end of Kuh-i-Safidar. Numerous villages here come into sight, most of them owing their existence to the generous supply of water afforded by the Kara Agach. Arrived at this point, the traveller will search perplexedly for the above river, of whose existence he will be doubtless aware, and which might be expected to flow *round* the hill. A walk of 3 miles up a gentle slope brings us opposite to the Tang-i-Tadun, a narrow gorge through which the Kara Agach, in defiance of present-day levels and necessities, forces its way *through* Kuh-i-Safidar, which is at this point about 500 feet above plain-level. On the slopes south of the east entrance to the gorge may be seen the ruins of an old fort, locally ascribed, like all old buildings in this part of Persia, to Zoroastrians. The remains of a stone bridge may also be observed in the middle of the gorge. When visited in March, 1907, the river was about 3 feet deep, but flowing so rapidly that it was impossible to keep one's footing, and no animal could possibly cross. Azimunjird itself is a pretty little village surrounded by orchards and irrigated fields. Similar villages occur at very frequent intervals on either side of the river from this point to Mazafri, and it would be difficult to find a more fertile little valley in all Persia. Villages on the west bank benefit, in addition, from hill springs and streams rising in Kuh-i-Safidar, which, owing to its position and height, receives far more snow and rain than the surrounding hills. Torrents of rain were several times observed on Kuh-i-

* = salt

† On the walls of the now deserted Shah Abbas *serai* at Mukhak, cut into the cement, and with every appearance of great age, the following strange inscription can be seen:—

Safidar, at a time when no rain was falling anywhere else. This fact doubtless accounts for the thicker population on the west bank. Mid-way between Azimunjird and Abbasabad the village of Babanar is passed, nestling in a valley $1\frac{1}{2}$ mile from the east bank of the river, and facing Kuh-i-Safidar. This is the limit of the date palm, which does not bear good fruit north of this village, although it is occasionally to be found in Shiraz.

A few miles south of Abbasabad the Kara Agach runs through another gorge, the sides of which disclose the distorted strata remarkably clearly. From Abbasabad the main road to Shiraz runs through Mazafri, or Akbarabad, across a flat plain, broken in places by low



BABANAR

hills, extensively irrigated, but presenting nothing of special interest. A few miles north of Akbarabad, at Baba Haji, the Firuzabad road joins the main Jahrum-Shiraz road. A more attractive though circuitous route to Shiraz diverges from Mazafri over the hills to the east into the Sarvistan plain, touching the pretty little village of Kunjun at the foot of the hills close to the Sarvistan-Maharlou road. This little village, like others on the fertile Sarvistan plain, is a veritable agricultural paradise. Grain grown in the district is noted for its flavour, and fetches a high price in the market, whilst water flows freely from inexhaustible streams, rendering the village independent of rainfall.

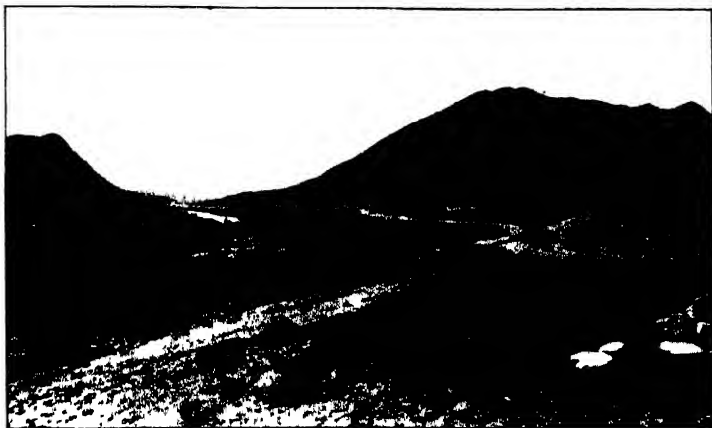
From Kunjun Shiraz may be reached by skirting either side of the Shiraz lake. If the traveller chooses the westerly track, past Maharlou village and over the Pul-i-Fasa, he will be taking the shortest road by a mile or two. The easterly track is described below. After about

6 miles across the open plain the south-east extremity of the lake is reached. The road from this point onwards follows closely the rugged shore, deeply indented wherever valleys debouch into the lake. Only once or twice does the road desert the shore in order to surmount a spit of land running far into the lake, and the traveller will gladly undertake the brief ascent in order to be rid for a time of the gnats which infest the reeking marshes that surely indicate an inflow of fresh water into the lake, which is itself extremely saline. Nothing is more surprising than the frequency with which fresh water springs, often of considerable size, are met with on the edges of the lake. Turtles and fresh-water fish abound in the lagoons formed by them, and ducks, waders, and many other kinds of bird breed in the dense marshes, for the existence of which fresh water is a necessity. There is no reason to think that similar fresh-water springs do not occur below the level of the lake, and in any estimate of the inflow into the lake it would be safe to assume that the volume from subterranean sources is considerably greater than that from the surface streams, attenuated as they are by the demands of irrigation.

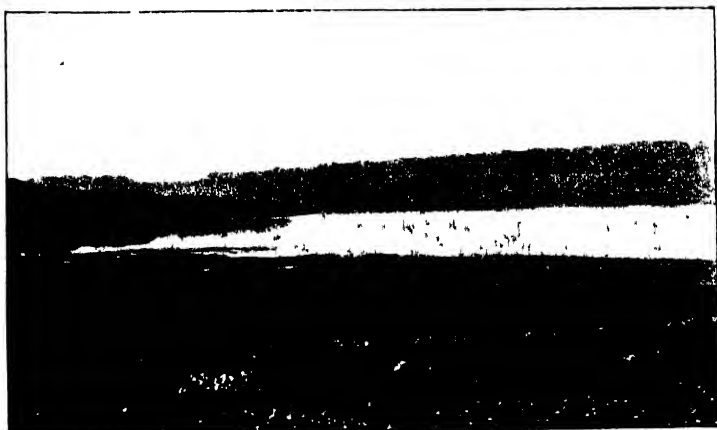
This lake presents some curious features to the geologist. The great Arab geographer Ibn Batuta makes no mention of it in his account of Shiraz, and Curzon considers this to be fairly satisfactory evidence of its recent formation. But if the lake be but eight hundred years old, how does it come to be so salt? The water flowing in is fresh, or practically so, and to bring the lake to its present state of saltiness a far greater period would no doubt be necessary. If, on the other hand, the lake is of great antiquity, contemporaneous with the surrounding hills, how is it that no depositions of rock-salt have been formed, and that the Sarvistan plain, which is only a few feet above the present water-level, is almost free from salt. The simplest explanation would seem to be that until comparatively recent times the lake, being deeper, had an outlet, but that as the rainfall diminished, the water-level sank below the level of the outlet, and an equilibrium was formed between evaporation and inflow. The general tendency of the lake is to diminish in volume, though very gradually. There is no evidence to support the theory of a subterranean channel whereby water escapes; did such a channel exist, the lake would probably not be saline. The northern extremity of the lake is occupied by broad marshes, the haunt of innumerable water-fowl and waders, and a paradise for the naturalist or sportsman. From lake to marsh, from marsh to reclaimed meadow, from meadow to irrigated field, the change is almost imperceptible until within sight of Shiraz, when the country once more assumes the normal aspect of a Persian valley.

The town of Shiraz has been so well depicted by Curzon, Sykes, and others, that to attempt any description of it would be at once presumptuous and unnecessary. Only in recent years, however, has

the tomb of Hafiz, the famous poet, been desecrated by the erection over it of a meretricious abomination, which, with its gaudily painted tin banners, badly designed scrollwork, and corrugated iron roof, is a



GORGE OF KARA AGACH, NEAR ISMAILABAD.



DANJA-I-MAHARLU, ON SHIRAZ LAKE.

monument of the bad taste of an Oriental, once he permits himself to depart from the national canons of art and architecture. One cannot help hoping that the Persian of a later age may some day awake to a sense of responsibility for the preservation of those glorious relics of

the past which, whatever be Persia's destiny, must still remain her most precious heritage.

I will terminate these notes by a few general observations upon certain aspects of our journey.

Major Sykes's statement* that the mountainous ridge between the Persian gulf and the interior of Persia offers formidable difficulties to engineering enterprise, can only be considered to apply to the region north of Bushire. Between Bandar Abbas and Shiraz the road, as will be gathered from previous pages, should the reader have had the patience to peruse them, traverses valley after valley, crossing from one to the other by means of low saddles, which would offer very little difficulty to an engineer. A good carriage-road, on the same scale as that between Tehran and Rasht, could be constructed very cheaply—far cheaper, at all events, than the above-mentioned road, between Bandar Abbas and Shiraz; whether it would pay as a commercial speculation is a point for experts on the spot to determine. The opinion of the writer is that it would *not* pay, though a railway very possibly would do so. From Jahrum to Shiraz the existing road is so easy that carts could be taken over it at a fair pace at once, a few hours' work here and there being all that is required to put the road on a par, at least, with the Isfahan-Shiraz cart-road.

As remarked by Curzon, the most marked feature of Persian orography is the way in which the mountain ranges, whose general direction is south south-east to north-north-west, are pierced, often near their highest point, by streams, sometimes large, but more often of insignificant size. His suggestion that these gorges are, in reality, fissures produced at the moment of upheaval, is supported by Loftus,† though Curzon himself quotes no authority. Examples of this phenomenon were frequently met with, notably the Tang-i-Kulún, near Juyun, and the Tang-i-Tadun.

It is perhaps worthy of remark that the principal watersheds of Persia are not the principal mountain ranges; the north and a large part of the south slopes of the Elburz drain into the Caspian sea; the dividing-line between rivers draining into the sea and those draining inland, where crossed near Shiraz, is for the most part only a low range of hills; the watershed between the Shor river and the Kara Agach river basins could only be traced with difficulty.

Irrigation.—There are no traces of irrigation works on a large scale having ever existed in the country between Jahrum and Shiraz, where alone sufficient water is found to make such enterprises profitable. There is little doubt that the Kara Agach, if dammed here and there and diverted into small canals, would water a far larger area than it

* 'Ten Thousand Miles in Persia,' p. 449.

† W. K. Loftus, *Quart. Journ. Geol. Soc.*, vol. 7, p. 263.

does at present; there is a large area of desert which only requires water to produce perennial crops of wheat, barley, and other grains. The Kara Agach, in the spring, flows at an average rate of about 7 miles an hour; its banks, moreover, are not very high; irrigation works, therefore, even at present, are easily carried out.

Population—From Bandar Abbas to Lar the country traversed by the road described above, and, indeed, on either side of the road for 30 miles, is practically uninhabited, the total population in this area being probably less than 3000. The numerous names on the map indicate, not villages, but desolate caravanserais. Travellers, therefore, have to rely largely on their own stocks for food for themselves, their servants, and animals.

Political Aspect of South Persia.—Probably no part of Persia is less subjected to the direct tyranny of the central government, at Teheran or Shiraz, than the coast districts of this part of Persia, Bandar Abbas always excepted. The “khans” are usually appointed for life from the same family; the government is more patriarchal than elsewhere, and active in other directions than tax-collecting only. The Khan of Lar was distinctly popular with his subjects, and deservedly so. Gun-running from Maskat, and the subsequent disposal of the rifles and ammunition thus obtained, is a welcome addition to the coffers of the chiefs who control the littoral, and this subject rivals highway robbery as the principal topic of conversation.

The position of South Persia, as might be expected, accounts for the really friendly sentiments of the people towards India and all things Indian; their political horizon is, however, surprisingly narrow. The Amir of Afghanistan was but a name to them, and his doings of no interest whatever. England, or rather London, was well known to every one as the place whence everything really good in the way of guns and high-class merchandise originated. England's connection with India was, however, not understood as a rule, and never fully appreciated.

In conclusion, I should add that, whilst responsible for the compilation of these notes, I have to thank Mr. A. H. P. Cruickshank, 32nd Sikh Pioneers, in conjunction and collaboration with whom the journey was undertaken, for the photographs, and, to no small extent, for the materials from which these notes were compiled.

COAST PEOPLES.*

By ELLEN CHURCHILL SEMPLE.

PART II.

Among coast-dwelling peoples we find every degree of intimacy with the water, from the amphibian life of many Malay tribes who love the wash of the waves beneath their pile-built villages, to the Nama bushmen who inhabit the dune-walled coast of South-West Africa, and know nothing of the sea. In the resulting nautical development the natural talents and habits of the people are of immense influence; but these in turn have been in part determined by the geographical environment of their previous habitat, whether inland or coastal, and by the duration in time, as well as the degree and necessity, of their contact with the sea. The Phœnicians, who, according to their traditions as variously interpreted, came to the coast of Lebanon either from the Persian gulf or the Red sea,† brought to their favourable maritime location a different endowment from that of the land-trading Philistines who moved up from the south to occupy the sand-choked shores of Palestine,‡ or from that of the Jews, bred to the grasslands of Mesopotamia and the grainfields of Egypt, who only at rare periods in their history forced their way to the sea.§ The unindented coast stretching from Cape Carmel south to the Nile delta never produced a maritime people and never achieved maritime importance, till a race of experienced mariners like the Greeks planted their colonies and built their harbour moles on the shores of Sharon and Philistia.|| So on the west face of Africa, from the Senegal southward along the whole Guinea Coast to Benguela, all evidences of kinship and tradition among the local tribes point to an origin on the interior plains and a recent migration seaward,¶ so that no previous schooling enabled them to exploit the numerous good harbours along this littoral, as did the sea-bred Portuguese and English.

Not only the accessibility of the coast from the sea, but also its habitability enters as a factor into its historical importance. A sandy desert coast, like that of South-West Africa and much of the Peruvian littoral, or a sterile mountain face, like that of Lower California, excludes the people of the country from the sea. Saldanha bay, the

* Continued from p. 90.

† Strabo, book xvi. ch. iii. 4, 27; Herodotus, book i. ch. i., book vii. ch. 89.

‡ George Adam Smith, 'Historical Geography of the Holy Land,' pp. 169-170. New York: 1897.

§ Ibid., pp. 179, 185, 286.

|| Ibid., pp. 127-131.

¶ F. Hatzel, 'History of Mankind,' vol. 3, pp. 100-102; and *passim*, 182-145. London: 1898.

one good natural harbour on the west coast of Cape Colony, is worthless even to the enterprising English, because it has no supply of fresh water.* The failure of the ancient Egyptians to take the short step forward from river to marine navigation can undoubtedly be traced to the fact that the sour swamps, barren sand-dunes, and pestilential marshes on the seaward side of the Nile delta must have always been sparsely populated as they are to-day,† and that a broad stretch of sandy waste backed their Red sea littoral.

On the other hand, where the hem of the continents is fertile enough to support a dense population, a large number of people are brought into contact with the sea, even where no elaborate articulation lengthens the shoreline. When this teeming humanity of a garden littoral is barred from landward expansion by desert or mountain, or by the already overcrowded population of its own hinterland, it wells over the brim of its home country, no matter how large, and overflows to other lands across the seas. The congested population of the fertile and indented coast of southern China, though not strictly speaking a sea-faring people, found an outlet for their redundant humanity and their commerce in the tropical Sunda islands. By the sixth century their trading junks were doing an active business in the harbours of Java, Sumatra, and Malacca; they had even reached Ceylon and the Persian gulf, and a little later were visiting the great focal market of Aden at the entrance of the Red sea.‡ A strong infusion of Chinese blood improved the Malay stock in the Sunda islands, and later in North Borneo and certain of the Philippines, whither their traders and emigrants turned in the fourteenth century, when they found their opportunities curtailed in the archipelago to the south by the spread of Islam.§ Now the "yellow peril" threatens the whole circle of these islands from Luzon to Sumatra.

Similarly India, first from its eastern, later from its western coast, sent a stream of traders, Bhuddist priests, and colonists to the Sunda islands, and especially to Java, as early as the fifth century of our era, whence Indian civilization, religion, and elements of the Sanskrit tongue spread to Borneo, Sumatra, Bali, Lombok, and even to some smaller islands among the Molucca group. The Hindus became the dominant commercial nation of the Indian ocean long before the great development of Arabian sea power, and later shared the trade of the East African coast with the merchants of Oman and Yemen.¶ To-day they

* H. R. Mill, 'International Geography,' p. 985. New York 1902.

† D. G. Hogarth, 'The Nearer East,' pp. 81, 166. London 1902.

‡ Hans Helmolt, 'History of the World,' vol. 2, p. 544, 593. New York 1904.

§ F. Ratzel, 'History of Mankind,' vol. 1, p. 397. London: 1896. 'Philippine Census,' vol. 1, pp. 438, 481-491. Washington: 1905.

¶ H. Helmolt, 'History of the World,' vol. 2, p. 547. New York: 1904.

¶ Ibid., vol. 3, pp. 431, 434.

form a considerable mercantile class in the ports of Maskat, Aden, Zanzibar, Pemba, and Natal.

On the coasts of large fertile areas like China and India, however, maritime activity comes not as an early, but as an eventual development, assumes not a dominant, but an incidental historical importance. The coastlands appearing early on the maritime stage of history, and playing a brilliant part in the drama of the sea, have been habitable, but their tillable fields have been limited either in fertility, as in New England, or in amount, as in Greece, or in both respects, as in Norway. But if blessed with advantageous location for international trade and many or even a few fairly good harbours, such coasts tend to develop wide maritime dominion and colonial expansion.

Great fertility in a narrow coastal belt barred from the interior serves to concentrate and energize the maritime activities of the nation. The 20-mile wide plain stretching along the foot of the Lebanon range from Antioch to Cape Carmel is even now the garden of Syria.* In ancient Phœnician days its abundant crops and vines supported luxuriant cities and a teeming population, which sailed and traded and colonized to the Atlantic outskirts of Europe and Africa. Moreover, their maritime ventures had a wide sweep as early as 1100 B.C. Quite similar to the Phœnician littoral and almost duplicating its history, is the Oman seaboard of eastern Arabia. Here again a fertile coastal plain sprinkled with its "hundred villages," edged with a few tolerable harbours, and backed by a high mountain wall with an expanse of desert beyond, produced a race of bold and skilful navigators,† who in the Middle Ages used their location between the Persian gulf and the Arabian sea to make themselves the dominant maritime power of the Indian ocean. With them maritime expansion was typically wide in its sweep and rapid in its development. Even before Mohammed's time they had reached India; but under the energizing influences of Islam, by 850 they had established a flourishing trade with China, for which they set up way-stations or staple-points in the Sunda islands.‡ First as voyagers and merchants, then as colonists, they came, bringing their wares and their religion to these distant shores. Marco Polo, visiting Sumatra in 1260, tells us the coast population was "Saracen," but this was probably more in religion than in blood. Oman ventures reached as far south as east. The trading stations of Makdishu and Barawa were established on the Somali coast of East Africa in 908, and Kilwa 750 miles further south in 925. In the seventeenth century the Oman Arabs dislodged the intruding Portuguese from all this coast belt down to the present northern boundary of Portuguese East Africa.

* D. G. Hogarth, 'The Nearer East,' pp. 111-112, 152. London: 1902.

† Ibid., pp. 73-74, 139, 267.

‡ H. Helmolt, 'History of the World,' vol. 2, p. 548. New York: 1904.

Even so late as 1850 their capital, Maskat, sent out fine merchantmen that did an expensive carrying trade, and might be seen loading in the ports of British India, in Singapore, Java, and Mauritius.

Brittany's active part in the maritime history of France is due, not only to its ragged contour, its inshore and offshore islands, its forward location on the Atlantic which brought it near to the fisheries of Newfoundland and the trade of the West Indies, but also to the fact that the "Golden Belt," which, with but few interruptions, forms a band of fertility along the coast, has supported a denser population than the sterile granitic soils of the interior,* while the sea near by varied and enriched the diet of the inhabitants by its abundance of fish, and in its limy seaweed yielded a valuable fertilizer for their gardens.† The small but countless alluvial deposits at the fiord heads in Norway, aided by the products of the sea, are able to support a considerable number of people. Hence the narrow coastal rim of that country shows always a density of population double or quadruple that of the next density belt towards the mountainous interior, and contains seventeen out of Norway's nineteen towns having more than 5000 inhabitants.‡ It is this relative fertility of the coastal regions, as opposed to the sterile interior, that has brought so large a part of Norway's people in contact with the Atlantic and given them a prominent place in maritime history.

Occasionally an infertile and sparsely inhabited littoral bordering a limited zone of singular productivity, especially if favourably located for international trade, will develop marked maritime activity, both in trade and commercial colonization. Such was Arabian Yemen, the home of the ancient Sabæans on the Red sea, stretching from the Straits of Bab-el-Mandeb north-westward for 500 miles. Here a mountain range, rising to 10,000 feet and bordering the plateau desert of central Arabia, condenses the vapours of the summer monsoon and creates a long-drawn oasis, where terraced coffee gardens and orchards blossom in the hot, moist air; but the arid coastal strip at its feet, harbouring a sparse population only along its trickling streams, has developed a series of considerable ports as outlets for the abundant products and crowded population of the highlands.§ A location on the busy sea lane leading from the Indian ocean to the Mediterranean, near the meeting-place of three continents, made the merchants of the Yemen coast, like the

* E. Lavisse, 'Histoire de France,' vol. 1, by P. Vidal de la Blache, 'Géographie de France,' pp. 335-337. Paris, 1903.

† Elisée Reclus, 'The Earth and its Inhabitants. Europe,' vol. 2, p. 252. New York, 1882.

‡ Norway, Official Publication for the Paris Exhibition, pp. 89-91, map of population, p. 4. Christiania, 1900.

§ D. G. Hogarth, 'The Nearer East,' pp. 114, 140, 163, 164, 202, 267. London, 1902.

Oman Arabs to the north, middlemen in the trade of Europe with eastern Africa and India.* Therefore, even in the second century these Sabseans had their trading stations scattered along the east coast of Africa as far south as Mozambique.† In 1502 Vasco da Gama found Arabs, either of Oman or Yemen, yet farther south in Sofala, the port for the ivory and gold trade. Some of them he employed as pilots to steer his course to India.‡

History makes one fact very plain: a people who dwell by the sea, and to whom nature applies some lash to drive them out upon the deep, command opportunity for practically unlimited expansion. In this way small and apparently ill-favoured strips of the Earth's surface have become the seats of wide maritime supremacy and colonial empire. The scattered but extensive seaboard possessions of little Venice and Genoa in the latter centuries of the Middle Ages are paralleled in modern times by the large oversea dominions of the English and Dutch.

Seaward expansions of peoples are always of great moment and generally of vast extent, whether they are the coastward movements of inland peoples to get a foothold upon the great oceanic highway of trade and civilization, as has been the case with the Russians notably since the early eighteenth century, and with numerous interior tribes of West Africa since the opening of the slave trade; or whether they represent the more rapid and extensive coastwise and oversea expansions of a maritime nation like the English, Dutch, and Portuguese. In either event they give rise to widespread displacements of peoples and a bizarre arrangement of race elements along the coast. When these two contrary movements meet, the shock of battle follows, as the recent history of the Russians and Japanese in Manchuria and Korea illustrates, the wars of Sweden and Russians for the possession of the eastern Baltic littoral, and the numerous minor conflicts that have occurred in Upper Guinea between European commercial powers and the would-be trading tribes of the bordering hinterland.

A coast region is always a peculiar habitat, inasmuch as it is more or less dominated by the sea. It is exposed to inundation by tidal wave and to occupation by immigrant fleets. It may be the base for outgoing maritime enterprise or the objective of some oversea movement, the dispenser or the recipient of colonists. The contrast between the inhabitants of the coast and the near-by inland people, which exists so widely, is to be traced, not so often to a difference of environment as to the more fundamental difference of race or tribe caused by immigration to accessible shores. The Greeks, crowded in their narrow peninsula of

* Strabo, book xvi. ch. iv. 2, 19.

† H. Helmolt, 'History of the World,' vol. 3, p. 133. New York. 1903

‡ James Bryce, 'Impressions of South Africa,' pp. 79, 82, 99. New York. 1897

limited fertility, wove an Hellenic border on the skirts of the Black sea and eastern Mediterranean lands, just as the Carthaginians added a fringe of aliens to North Africa, where the Punic people of the coast presented a marked contrast to the Berbers of the interior. Detached from its hinterland, it developed an almost purely maritime history,* except when some tide of conquest or migration from the nomad-breeding plateau overwhelmed the littoral.

An ethnographical map of Russia to-day shows a narrow but almost continuous rim of Germans stretching from the river Niemen north through the Baltic coast of Courland, Livland, and Esthland, as far as Revel; and again, a similar band of Swedes along the seaboard of Finland, from a point east of Helsingfors on the south around to Uleaborg on the north,† dating from the time when Finland was a political dependency of Sweden, and influenced by the fact that the frozen Gulf of Bothnia every winter makes a bridge of ice between the two shores.

Everywhere in the Melanesian archipelago, where Papuans and Malays dwell side by side, the latter as the new-comers are always found in possession of the coast, while the darker aborigines have withdrawn into the interior. So in the Philippines, the aboriginal Negritos, pure or more often mixed with Malayan blood, as in the Mangyan tribe of central Mindoro, are found crowded back into the interior by the successive invasions of Malays who have encircled the coasts. The Zamboanga peninsula of Mindanao has an inland pagan population of the primitive Malayan race called Subanon, who have been displaced from the littoral by the seafaring Samal Moros, Mohammedanized Malays from the east shores of Sumatra and the adjacent islands, who spread northward about 1300 under the energizing impulse of their new religion.‡ Even at so late a date as the arrival of Magellan, the Subanon seem to have still occupied some points of the coast,§ just as the savage Ainos of the island of Yezo touched the sea about Sapporo only forty years ago, though they are now surrounded by a seaboard rim of Japanese.

If we turn to South America, we find that warlike Tupi, at the time of the discovery, occupied the whole Brazilian coast from the southern tropic north to eastern Guiana, where the Tupi element is still strong, while the highlands of eastern Brazil immediately in their rear were populated by tribes of Ges, who had been displaced by the coastwise

* Ernst Curtius, 'History of Greece,' vol. 1, pp. 12-13. New York

† Anatole Leroy Beaulieu, 'The Empire of the Tsars,' vol. 1. Map facing p. 80 New York

‡ Philippine Census, vol. 1, pp. 412, 413, 461, 464, 562. Washington: 1905.

§ Ibid., vol. 1, p. 416.

¶ F. Ratzel, 'History of Mankind,' vol. 3, p. 449. London: 1898.

expansion of the Tupi canoemen.* And to-day this same belt of coast-land has been appropriated by a foreign population of Europeans and Negroes, whilst the vast interior of Brazil shows a predominance of native Indian stocks, only broken here and there by a lonely *enclave* of Portuguese settlement. The early English and French territories in America presented this same contrast of coast and inland people—the colonists planting themselves on the hem of the continent to preserve maritime connection with the home countries, the aborigines forced back beyond reach of the tide.

Wherever an energetic seafaring people with marked commercial or colonizing bent makes a highway of the deep, they give rise to this distinction of coast and inland people on whatever shores they touch. The Phœnicians and Greeks did it in the Mediterranean; the expanding Angles and Saxons in the North sea and the Channel, where they stretched their *litus Saxonicum* along the coast of the continent to the apex of Brittany, and along the hem of England from Southampton Water to the Firth of Forth;† the sea-bred Scandinavians farther north in the Teutonic fringe of settlements which they placed on the shores of Celtic Scotland and Ireland.‡

As a rule it is the new-comers who hold the coast, but occasionally the coast-dwellers represent the older ethnic stock. In the Balkan peninsula to-day the descendants of the ancient Hellenes are, with few exceptions, confined to the coast. The reason is to be found in the fact that the Slavs and other northern races who have intruded by successive invasions from the plains of southern Russia are primarily an inland people, and therefore have occupied the core of the peninsula, forcing the original Greek population before them to the edge of the sea.§ This is the same anthropogeographical process which makes so many peninsulas the last halting-place of a dislodged earlier race. But the Greeks who line the northern and western shores of Asiatic Turkey are such only in language and religion, because their prevailing broad head-form shows them to be Turks and Armenians in race stock.||

Sometimes the distinction of race between coast and interior is obliterated so far as language and civilization are concerned, but survives less conspicuously in head-form and pigmentation. The outermost fringe of the Norwegian coast, from the extreme south to the

* H. Helmolt, 'History of the World,' vol. 1, p. 185. Ethnographical map. New York: 1902. Paul Ehrenreich, "Die Eintheilung und Verbreitung der Völkerstämme Brasiliens," *Petermann's Mittheilungen*, vol. 37, pp. 88, 89. Gotha: 1891.

† J. R. Green, 'The Making of England,' vol. 1, ch. i. "The Conquest of the Saxon Shore." London: 1904.

‡ H. J. Mackinder, 'Britain and the British Seas,' p. 189. London: 1904. W. Z. Ripley, 'The Races of Europe,' pp. 313-315, map. New York: 1899.

§ D. G. Hogarth, 'The Nearer East,' p. 152. London: 1902. W. Z. Ripley, 'The Races of Europe,' pp. 402, 404, map. New York: 1899.

|| Ibid., pp. 117, 404, 405, 409, 410.

latitude of Trondhjem in the north, is occupied by a broad-headed, round-faced, rather dark people of only medium height, who show decided affinities with the Alpine race of Central Europe, and who present a marked contrast to the tall narrow-headed blondes of pure Teutonic type, constituting the prevailing population from the inner edge of the coast eastward into Sweden. This brachycephalic, un-Germanic stock of the western Norwegian coast seems to represent the last stand made by that once wide-spread Alpine race which here has been shoved along to the rocky capes and islands of the outer edge by a later immigration of German stock coming from Sweden.* So the largest continuous area of Negrito stock in the Philippines is found in the Sierra Madre mountains defining the eastern coast of northern Luzon.† Facing the neighbourless wastes of the Pacific, whence no new settler could come, turned away from the sources of Malay immigration to the south-west, it was given a location to make it a retreat, rather than a gateway to incoming races.

Where an immigrant population from oversea lands occupies the coastal hem of a country, rarely do they preserve the purity of their race. Coming at first with marauding or trading intent, they bring no women with them, but institute their trading stations or colonies by marriage with the women of the country. The ethnic character of the resultant population depends upon the proportion of the two constituent elements, the nearness or remoteness of their previous kinship, and the degree of innate race antagonism. The various Greek elements which crossed the Ægean from different sections of the peninsula to colonize the Ionic coast of Asia Minor mingled with the native Carian, Cretan, Lydian, Pelasgian, and Phœnician populations which they found there.‡ On all the barbarian shores where the Greeks established themselves, there arose a mixed race—in Celtic Massilia, in Libyan Barca, and in Scythian Crimea—but always a race Hellenized, born interpreters and mercantile agents.§ A maritime people, engrossed chiefly with the idea of trade, moves in small groups and intermittently; hence it modifies the original coastal population less than does a genuine colonizing nation, especially as it prefers the smallest possible territorial base for its operations. The Arab element in the coast population of East Africa is strongly represented, but not so strongly as one might expect after a thousand years of intercourse, because it was scattered in detached seaboard points, only few of which were really stable. The native population of Zanzibar and Pemba and the fringe of coast tribes on the mainland opposite are clearly tinged with Arab blood. These Swahili, as they

* W. Z. Ripley, 'The Races of Europe,' pp. 206-208, 210-212. Norway, Official Publication for the Paris Exhibition, pp. 80-81. Christiania: 1900.

† Philippine Census, vol. 2, p. 52, map, p. 50. Washington: 1905.

‡ Grote, 'History of Greece,' vol. 3, pp. 175, 176, 186-189. New York: 1857.

§ Ernst Curtius, 'History of Greece,' vol. 1, book ii. pp. 492-493. New York

are called, are a highly mixed race, as their negro element has been derived not only from the local coast peoples, but also from the slaves who for centuries have been halting here on their seaward journey from the interior of Africa.*

Coast peoples tend to show something more than the hybridism resulting from the mingling of two stocks. So soon as the art of navigation developed beyond its initial phase of mere coastwise travel, and began to strike out across the deep, all coast peoples bordered upon each other, and the sea became a common waste boundary between. Unlike a land boundary, which is in general accessible from only two sides and tends to show, therefore, only two constituent elements in its border population, a sea boundary is accessible from many directions with almost equal ease; it therefore draws from many lands, and gives its population a variety of ethnic elements and a cosmopolitan stamp. This, however, is most marked in great seaports, but from them it penetrates into the surrounding country. The whole southern and eastern coast population of England, from Cornwall to the Wash, received during Elizabeth's reign valuable accessions of industrious Flemings and Huguenots, refugees from Catholic persecution in the Netherlands and France.† Our north Atlantic states, whose population is more than half (50·9 per cent.) made up of aliens and natives born of foreign parents,‡ have drawn their elements from almost the whole circle of Atlantic shores, from Norway to Argentine and from Argentine to Newfoundland. Even the Southern States, so long unattractive to immigrants on account of the low status of labour, show a fringe of various foreign elements along the Gulf coast, the deeper tint of which on the census maps fades off rapidly towards the interior. The same phenomenon appears with Asiatic and Australian elements in our Pacific seaboard states.§ The cosmopolitan population of New York, with its "Chinatown," its "Little Italy," its Russian and Hungarian quarters, has its counterpart in the mixed population of Maskat, peopled by Hindus, Arabs, Persians, Kurds, Afghans, and Beluchis, settled here for purposes of trade, or the equally mongrel inhabitants of Aden and Zanzibar, of Marseilles, Constantinople, Alexandria, Port Said, and so many other Mediterranean ports.

The cosmopolitanism and the commercial activity that characterize so many seaboard are reflected in the fact that, with rare exceptions, it is the coast regions of the world that give rise to a *lingua franca* or *lingua geral*. The original *lingua franca* arose on the coast of the Levant during the period of Italian commercial supremacy there; it consisted of an

* F. Ratzel, 'History of Mankind,' vol. 2, pp. 580-533. London: 1898.

† H. D. Trail, 'Social England,' vol. 3, pp. 367-368. London and New York: 1895.

‡ Twelfth Census, Bulletin, No. 103, table 23. Washington: 1902.

§ Ellen C. Semple, 'America and its Geographic Conditions,' pp. 314-315, 318-323, 326-328. Boston: 1903.

Italian stock, on which were grafted Greek, Arabic, and Turkish words, and was the regular language of trade for French, Spanish, and Italians.* It is still spoken in many Mediterranean ports, especially in Smyrna, and in the early part of the nineteenth century was in use from Madagascar to the Philippines.† In the coastal strip of the Zanzibar Arabs, recently transferred to German East Africa, the speech of the Swahili has become a means of communication over a great part of East Africa, from the coast to the Congo and the sources of the Nile. It is a Bantu dialect permeated with Arabic and Hindu terms, and sparsely sprinkled even with English and German words.‡ “Pidgin English” (business English) performs the function of a *lingua franca* in the ports of China and the Far East. It is a jargon of corrupted English with a slight mixture of Chinese, Malay, and Portuguese words, arranged according to the Chinese idiom. Another mongrel English does service on the coast of New Guinea. The “Nigger English” of the West African trade is a regular dialect among the natives of the Sierra Leone coast. Farther east, along the Upper Guinea littoral, the Eboe family of tribes who extend across the Niger delta from Lagos to Old Calabar have furnished a language of trade in one of their dialects.§ The Tupi speech of the Brazilian coast Indians, with whom the explorers first came into contact, became, in the mouth of Portuguese traders and Jesuit missionaries, the *lingua geral* or medium of communication between the whites and the various Indian tribes throughout Brazil.|| The Chinook Indians, located on our Pacific coast north and south of the Columbia river, have furnished a jargon of Indian, French, and English words which serves as a language of trade throughout a long stretch of the north-west Pacific coast, not only between whites and Indians, but also between Indians of different linguistic stocks.¶

The coast is the natural habitat of the middleman. One strip of seaboard produces a middleman people, and then sends it out to appropriate other littorals, if geographic conditions are favourable; otherwise it is content with the transit trade of its own locality. It breeds essentially a race of merchants, shunning varied production, nursing monopoly by secrecy and every method to crush competition. The profits of trade attract all the free population, and the labouring class is small or slave. Expansion landward has no attraction in comparison with the seaward expansion of commerce. The result is often a relative

* G. G. Chisholm, ‘Commercial Geography,’ p. 58. London: 1904.

† W. Roscher, ‘Nationalökonomik des Handels und Gewerbleisses,’ note 18. p. 85. Stuttgart: 1899.

‡ F. Ratzel, ‘History of Mankind,’ vol. 2, p. 533. London: 1898.

§ Ibid., vol. 2, pp. 139, 145.

|| H. R. Mill, ‘International Geography,’ p. 869. New York: 1902.

¶ D. G. Brieton, ‘The American Race,’ p. 107. Philadelphia: 1901.

dearth of local land-grown food stuffs. King Hiram of Troy, in his letter to King Solomon, promised to send him trees of cedar and cypress, made into rafts and conveyed to the coast of Phillistia, and asked in return for grain, "which we stand in need of because we inhabit an island." The pay came in the form of wheat, oil, and wine. But Solomon furnished a considerable part of the labourers—30,000 of them—who were sent, 10,000 at a time, to Mount Lebanon to cut the timber, apparently under the direction of the more skilful Sidonian foresters.* A type of true coast traders is found in the Duallas of the German Kamerun, at the inner angle of the Gulf of Guinea. Located along the lower course and delta of the Mungo river where it flows into the Kamerun estuary, they command a good route through a mountainous country into the interior. This they guard jealously, excluding all competition, monopolizing the trade, and imposing a transit duty on all articles going to and from the interior. Like the ancient Phœnicians and Carthaginians, they avoid agriculture so far as possible. Their women and slaves produce an inadequate supply of bananas and yams, but crops needing much labour are wholly neglected, so that their coasts have a reputation for dearth of provisions.†

Along the 4500 miles of West African coast between the Senegal and the Kunene river the Negro's natural talent for trade has developed special tribes, who act as intermediaries between the interior and the European stations on the seaboard. Among these we find the Bihenos and Banda of Portuguese Benguela, who fit out whole caravans for the back country; the Portuguese of Loanda rely on the Ambaquistas and the Mbunda. The slave trade particularly brought a sinister and abnormal activity to these seaboard tribes,‡ just as it did to the East Coast tribes, and stimulated both in the exploitation of their geographic position as middlemen.§

The Alaskan coast shows the same development. The Kinik Indians at the head of Cook's inlet buy skins of land animals from the inland Athapascans at the sources of the Copper river, and then make a good profit by selling them to the American traders of the coast. These same Athapascans for a long time found a similar body of middlemen in the Ugalentz at the mouth of the Copper river, till the Americans there encouraged the inland hunters to bring their skins to the fur station on the coast.|| The Chiloats at the head of Lynn canal long monopolized the fur trade with the Athapaskan Indians about Chilkoot pass; these they would meet on the divide and buy their skins, which they would carry to the Hudson Bay Company agents on the coast. They guarded

* Josephus, 'Antiquities of the Jews,' book viii. ch. ii. 6, 7, 9.

† F. Batzel, 'History of Mankind,' vol. 3, pp. 121, 122. London: 1898.

‡ Ibid., vol. 3, pp. 121, 132, 133.

§ Ibid., vol. 2, p. 239.

|| Eleventh Census Report, 'Alaska,' p. 70. Washington: 1893.

their monopoly jealously, and for fifty years were able to exclude all traders and miners from the passes leading to the Yukon.*

The same policy of monopoly and exclusion has been pursued by the Moro coast dwellers of Mindanao in relation to the pagan tribes of the interior. They buy at Moro prices the forest and agriculture products of the inland Malays, whom they do not permit to approach either rivers or seaboard, for fear they may come into contact with the Chinese merchants along the coast. So fiercely is their monopoly guarded by this middleman race, that the American Government in the Philippines will be able to break it only by military interference.†

Differences of occupation, of food supply, and of climate often further operate to differentiate the coast from the inland people near by, and to emphasize the ethnic difference which is almost invariably present, either inconspicuously from a slight infusion of alien blood, or plainly as in an immigrant race. Sometimes the contrast is in physique. In Finisterre province of western Brittany, the people along the more fertile coastal strip are on the average an inch taller than the inhabitants of the barren, granitic interior. Their more generous food supply, further enriched by the abundant fisheries at their doors, would account for this increased stature; but this must also be attributed in part to intermixture of the local Celts with a tall Teutonic stock which brushed along these shores, but did not penetrate into the unattractive interior.‡ So the negroes of the Guinea Coast, though not immune from fevers, since they are better nourished on the fertile alluvial lowlands near the abundant fish of the lagoons, are often stronger and better looking than the plateau interior tribes near by. But here, again, an advantageous blending of races can not be excluded as a contributing cause.§ Sometimes the advantage in physique falls to the inland people, especially in tropical countries when a highland interior is contrasted with a low coast belt. The wild Igorotes, inhabiting the mountainous interior of northern Luzon, enjoy a cooler climate than the lowlands, and this has resulted in developing in them a decidedly better physique and more industrious habits than are found in the civilized people of the coasts encircling them.||

Sometimes the difference is in shade of colour between two closely related tribes of the same race, due to the deeper pigmentation of the fishing, seafaring coast folk, especially in tropical regions. The coast Moros of western Mindanao are darker than the Subanos, their Malay brethren of the interior, the lightness of whose colour can be explained

* Eleventh Census Report, "Alaska," p. 156. Eliza R. Seidmore, 'Guidebook to Alaska,' p. 94. New York: 1897.

† Philippine Census, vol. 1, pp. 556-561, 575, 581-583. Washington: 1903.

‡ W. Z. Ripley, 'The Races of Europe,' pp. 85, 86, 99-101. With map, 151-152. New York: 1899.

§ F. Ratzel, 'History of Mankind,' vol. 3, pp. 97, 106. New York: 1898.

|| Henry Gannett, "The People of the Philippines," in Report of the Eighth International Geographic Congress. Washington: 1904.

by their spending most of their lives in the forests.* So the Duallas of the Kamerun coast are darker than the Bakwiri inhabiting the forest slope of the mountains just behind them, though both belong to the Bantu group of people.†

Where a coast people is an immigrant stock from some remote over-sea point, it brings to its new home a surplus of energy which was perhaps the basis of selection in the exodus from the mother country. Such a people is therefore characterized by greater initiative, enterprise, and endurance than the sedentary population which it left behind or that to which it comes; and these qualities are often further stimulated by the transfer to a new environment rich in opportunities. Sea-born in their origin, sea-born in their migration, they cling to the zone of littoral, because here they find the conditions which they best know how to exploit. Dwelling on the highway of the ocean, living in easy intercourse with distant countries which would have been far more difficult of access by land-travel over territories inhabited by hostile races, exchanging with these both commodities and ideas, food-stuffs and religions, they become the children of civilization, and their sun-burned seamen the sturdy apostles of progress. Therefore it may be laid down as a general proposition, that the coasts of a country are the first part of it to develop, not an indigenous or local civilization, but a cosmopolitan culture, which later spreads inland from the seaboard.

Exceptions to this rule are found in barren, swampy, or inaccessible coasts like the Pacific littoral of Peru and Mexico, and on shores like those of western Africa and eastern Luzon, which occupy an adverse geographic location facing a neighbourless expanse of ocean and remote from the world's earlier foci of civilization. Therefore the descent from the equatorial plateau of Africa down to the Atlantic littoral means a drop in culture also, because the various elements of civilization which, since the days of Phœnician and Yemen seamen, have uninterruptedly filtered in from the Mediterranean and the Red sea, have rarely penetrated so far as the western rim of the highland, and hence never reached the coast. So the remote Adriatic face of Greece received only faint echoes from the joyous choruses of Ægean civilization; so the western shores of the Iberian peninsula and of the British isles, during the ancient and mediæval periods of history, had their backs turned on the tumult of life and trade and progress about the Mediterranean and North sea shores.

The long, indented coast of the Mediterranean has in all ages presented the contrast of a littoral more advanced in civilization than the inland districts. The only possible exceptions are to be found in ancient Egypt before Psammetichus began to exploit his mud-choked seaboard, and in northern Italy of the last two decades, since the utilization of

* Philippine Census, vol. 1, p. 552. Washington: 1903.

† F. Ratzel, 'History of Mankind,' vol. 3, p. 106. London: 1898.

Alpine water-power. This contrast was apparent, not only wherever Phœnicians or Greeks had appropriated the remote coast of an alien and retarded people; even in near-by Thrace the savage habits of the interior tribes were softened only where these dwelt in close proximity to the Ionian colonies along the coast, a fact as noticeable in the time of Tacitus as in that of Herodotus five hundred years before.* The ancient philosophers of Greece were awake to the deep-rooted differences between an inland and a maritime city, especially in respect to receptivity of ideas, activity of intellect, and affinity for culture.†

If we turn to the Philippines, we find that 65 per cent. of the Christian or civilized population of the islands live on or near the coast; and of the remaining 35 per cent. dwelling inland, by far the greater part represents simply the landward extension of the area of Christian civilization which had Manila bay for a nucleus.‡ Otherwise, all the interior districts are occupied by wild or pagan tribes. Mohammedanism, too, a religion of civilization, rims the southernmost islands which face the eastern distributing point of the faith in Java; it is confined to the coasts, except for its one inland area of expansion along the lake and river system of the Rio Grande of Mindanao, which afforded an inland extension of sea navigation for the small Moro boat.

Coasts are areas of out-going and in-coming maritime influences. The nature and amount of these influences depend upon the sea or ocean whose rim the coast in question helps to form, and the relations of that coast to its other tide-washed shores. Our land-made point of view dominates us so completely, that we are prone to consider a coast as margin of its land, and not also as margin of its sea, whence, moreover, it receives the most important contributions to its development. The geographic location of a coast as part of a thalassic or of an oceanic rim is the most potent factor in its history; more potent than local conditions of fertility, irregular contour, and accessibility from sea and hinterland. Everything that can be said about the different degrees of historical importance attaching to inland seas and open oceans in successive ages applies equally to the countries and peoples along their shores; and everything that enhances or diminishes the cultural possibilities of a sea—its size, zonal location, its relation to the oceans and continents—finds its expression in the life along its coasts.

The anthropogeographical evolution which has passed from small to large states and from small to large seas as fields of maritime activity has been attended by a continuous change in the value of coasts according as these were located on enclosed basins like the Mediterranean, Red, and Baltic; on marginal ones like the China and North seas; or on the open ocean. In the earlier periods of the world's

* Grote, 'History of Greece,' vol. 4, p. 22. New York: 1857.

† Ibid., vol. 2, pp. 225, 226.

‡ Philippine Census, vol. 2, pp. 84, 85, map, p. 28. Washington: 1903.

history, a location on a relatively small enclosed sea gave a maritime horizon wide enough to lure, but not so wide as to intimidate; and by its seclusion led to a concentration and intensification of historical development, which in many of its phases left models for subsequent ages to wonder at and imitate. This formative period and formative environment outgrown, historical development was transferred to locations on the open oceans, according to the law of human advance from smaller to larger areas; so the historical importance of the Mediterranean and the Baltic shores was transitory, a prelude to the larger importance of the Atlantic littoral of Europe, just as this in turn was to attain its full significance only when the circumnavigation of Africa and South America linked the Atlantic to the World ocean. Thus that gradual expansion of the geographic horizon which has accompanied the progress of history has seen a slow evolution in the value of seaboard locations, the transfer of maritime leadership from small to large basins, from thalassic to oceanic ports, from Lubeck to Hamburg, from Venice to Genoa, as earlier from the Piræus to Ostia, and later from England's little *Cinque Ports* to Liverpool and the Clyde.

Though the articulations of a coast determine the ease with which maritime influences are communicated to the land, nevertheless history shows repeated instances where an exceptional location, combined with restricted area, has raised a poorly indented seaboard to maritime and cultural pre-eminence. Phœnicia's brilliant history rose superior to the limitation of indifferent harbours, owing to a position on the Arabian isthmus between the Mediterranean and the Indian ocean at the meeting-place of Europe, Asia, and Africa. Moreover, the advantages of this particular location have in various times and in various degrees brought into prominence all parts of the Syrian and Egyptian coasts from Antioch to Alexandria. So the whole stretch of coast around the head of the Adriatic, marking the conjunction of a busy sea-route with various land-routes over the encircling mountains from Central Europe, has seen during the ages a long succession of thriving maritime cities, in spite of fast-silting harbours and impeded connection with the hinterland. Here in turn have ruled with maritime sway Spina, Ravenna, Aquileia,* Venice, and Trieste. On the other side of the Italian peninsula, the location on the northernmost inlet of the western Mediterranean and at the seaward base of the Ligurian Apennines, just where this range opens two passes of only 1800 feet elevation to the upper Po valley, made an active maritime town of Genoa from Strabo's day to the present. In its incipency it relied upon one mediocre harbour on an otherwise harbourless coast, a local supply of timber for its ships, and a road northward across the mountains.† The maritime ascendancy in the Middle Ages of Genoa, Pisa, Venice,

* Strabo, book v. ch. i. 7, 8.

† Strabo, book iv. ch. vi. 1, 2: book v. ch. i. 11.

and Barcelona proves that no long indented coast is necessary, but only one tolerable harbour coupled with an advantageous location.

Owing to the ease and cheapness of water transportation, a seaboard position between two other coasts of contrasted products, due to a difference either of zonal location or of economic development or of both combined, ensures commercial exchanges and the inevitable activities of the middleman. The position of Carthage near the centre of the Mediterranean enabled her to fatten on the trade between the highly developed eastern basin and the retarded western one. Midway between the teeming industrial towns of mediæval Flanders, Holland, and western Germany, and the new unexploited districts of unprogressive Russia, Poland, and Scandinavia, lay the long line of the German Hanseatic towns—Kiel, Lübeck, Wismar, Rostock, Stralsund, Greifswald, Anklam, Stettin, and Colberg, the *civitates maritimæ*, who for three centuries or more made themselves the dominant commercial and maritime power of the Baltic by exchanging Flemish fabrics, German hardware, and Spanish wines for the furs and wax of Russian forests, tallow and hides from Polish pastures, and crude metals from Swedish mines.* So Portugal by its geographical location became a staple place where the tropical products from the East Indies were transferred to the vessels of Dutch merchants, and by them distributed to northern Europe; later New England, by a parallel location, became the middleman in the exchanges of the tropical products of the West Indies, the tobacco of Virginia, and the wheat of Maryland for the manufactured wares of England and the fish of Newfoundland.

Primitive or early maritime commerce has always been characterized by the short boat, a succession of middlemen coasts, and a close series of staple places, such as served the North Indian ocean trade in Oman, Malabar coast, Ceylon, Coromandel coast, Malacca, and Java. Therefore, many a littoral admirably situated for middleman trade loses this advantage so soon as commerce matures enough to extend the sweep of its voyages, and to bring into direct contact the two nations for which that coast was intermediary. This is only another aspect of the anthropogeographic evolution from small to large areas. The decline of the Mediterranean coasts followed close upon the discovery of the sea-route to India; nor was their local importance restored by the Suez canal. Portugal declined when the Dutch, excluded from the Tagus mouth on the union of Portugal with Spain, found their way to the Spice isles. Ceylon, though still the chief port of call in the Indian ocean, has lost its pre-eminence as chief market for all the lands between Africa and China, which it enjoyed in the sixth century A.D., owing to the "long haul" of modern oceanic commerce.

Not only that far-reaching readjustment of maritime ascendancy

* Dietrich Schäfer, 'Die Hansestädte und König Waldemar von Danemark,' pp. 184, 189. Jena: 1879.

which in the sixteenth century followed the advance from thalassic to oceanic fields of commerce, but also purely local political events may produce as striking changes in the use or importance of coasts. The Piræus, which had been the heart of ancient Athens, almost wholly lost its value in the checkered political history of the country during the Middle Ages, when naval power and merchant marine almost vanished; but with the restoration of Grecian independence in 1832, much of its pristine activity was restored. Up to the beginning of the seventeenth century, Japan had exploited her advantageous location and her richly indented coast to develop a maritime trade which extended from Kamchatka to India; but in 1624 an imperial order withdrew every Japanese vessel from the high seas, and for over two hundred years robbed her busy littoral of all its historical significance. The real life of the Pacific coast of the United States began only with its incorporation into the territory of the Republic, but it failed to attain its full importance until our acquisition of Alaska, Hawaii, and the Philippines. So the coast of the Persian gulf has had periods of activity alternating with periods of deathlike quiet. Its conquest by the Saracens in the seventh century inaugurated an era of intense maritime enterprise along its drowsy shores: what new awakening may it experience, if it should one day become a Russian littoral!

Sometimes the decline in historical importance is due to physical modifications in the coast itself, especially where the mud transported by a great river to the sea is constantly pushing forward the shoreline. The control of the Adriatic passed in turn from Spina to Adria, Ravenna, Aquileia, Venice, and Trieste, owing to a steady silting up of the coast.* Strabo records that Spina, originally a port, was in his time 90 stadia, or 10 miles, from the sea.† Bruges, once the great *entrepôt* of the Hanseatic League, was originally on an arm of the sea, with which it was later connected by canal, and which has been silted up since 1432, so that its commerce, disturbed too by local wars, was transferred to Antwerp on the Scheldt.‡ Many early English ports on the coast of Kent and on the old solid rim of the Fenland marshes now lie miles inland from the Channel and the Wash.

A people never utilizes all parts of its coasts with equal intensity, or any part with equal intensity in all periods of its development; but, according to the law of differentiation, it gradually concentrates its energies in a few favoured ports, whose maritime business tends to become specialized; while every extension of the subsidiary territory and intensification of production with advance in civilization increases the mass of men and wares passing through these ocean gateways. The

* W. Deecke, 'Italy,' pp. 89-91. London: 1904.

† Strabo, book iii. ch. i. 2.

‡ W. Roscher, 'Nationalökonomik des Handels und Gewerbefleisses,' p. 93, note 1. Stuttgart: 1899.

shores of New York, Delaware, and Chesapeake bays are more important to the country now than they were in early colonial days, when their back country extended only to the watershed of the Appalachian system. Our Gulf coast has gained in activity with the South's economic advance from slave to free labour, and from almost exclusive cotton planting to diversified production combined with industries; and it will come into its own, in a maritime sense, when the opening of the Panama canal will divert from the Atlantic outlets those products of the Mississippi basin which will be seeking trans-Pacific markets.

A careful analysis of the life of coast peoples in relation to all the factors of their land and sea environment shows that these are multiform, and that none are negligible; it takes into consideration the extent, fertility, and relief of the littoral, its accessibility from the land as well as from the sea, and its location in regard to outlying islands and to opposite shores, whether near or far; it holds in view not only the small articulations that give the littoral ready contact with the sea, but its relation to the larger continental articulations, whether it lies on an outrunning spur of a continental mass, like the Malacca, Yemen, or Peloponesian coast, or upon a retiring inlet that brings it far into the heart of a continent, and provides it with an extensive hinterland; and, finally, it never ignores the nature of the bordering sea, which furnishes the school for the learning of seamanship and fixes the scope of maritime enterprise.

But all these various elements of coastal environment are differentiated in their use and their influence according to the purposes of those who come to tenant such tide-washed rims of the land. Pirates seek intricate channels and hidden inlets for their lairs; a merchant people select populous harbours and navigable river mouths; would-be colonists settle upon fertile valleys opening into quiet bays, till their fields, and use their coasts for placid maritime trade with the mother country; interior peoples, pushed or pushing out to the tidal periphery of their continent, with no maritime history behind them, build their fishing villages on protected lagoons, and, unless the shadowy form of some outlying island lure them farther, there they tarry, deaf to the siren song of the sea.

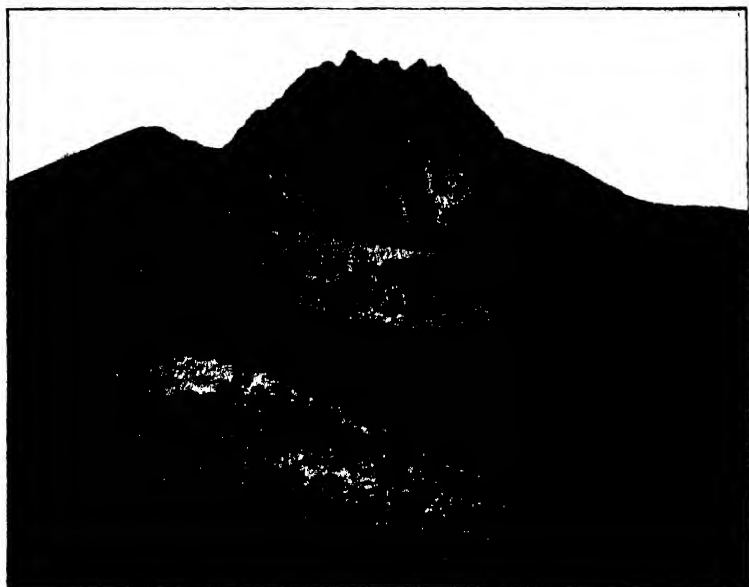
NOTES ON THE PHYSIOGRAPHY OF CERTAIN VOLCANOES IN NORTHERN JAPAN.

By C. E. BRUCE MITFORD.

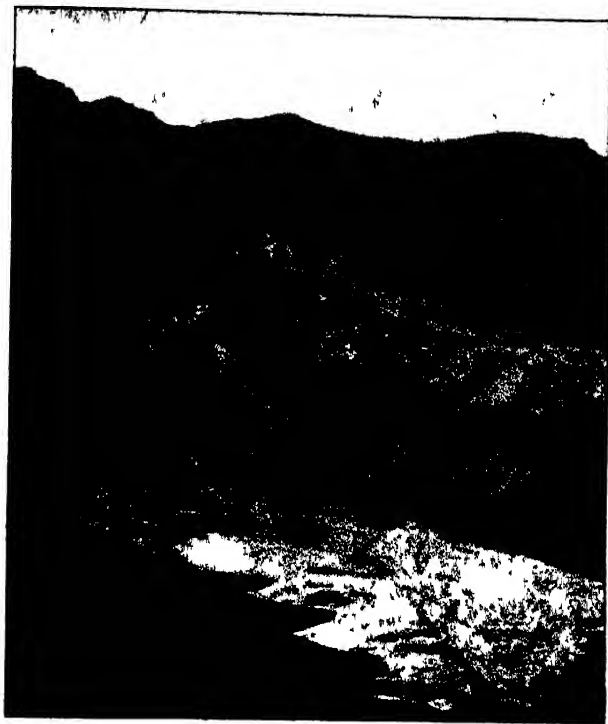
OF the four "lines of weakness" which, marked by volcanic ranges, traverse the islands of Japan, the greatest is that which extends in a well-defined anti-clinal curve from south-western Yezo along the backbone of Hondo to the lofty transverse upfold of the so-called Japanese Alps. At several points in this line subsidiary lines of fracture, running



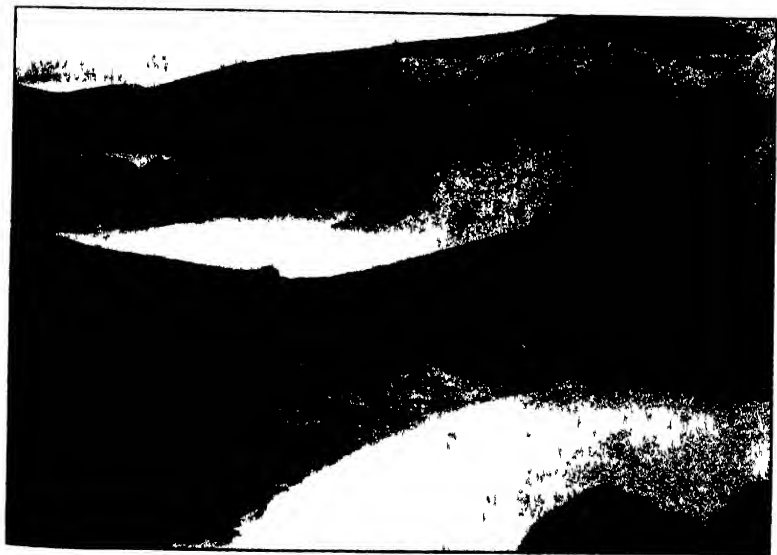
KOMAGATAKE FROM LAKE ONUMA.



THE KOMAGATAKE OF YEZO : ANCIENT WALL AND PINNACLE.



THE KOMAGATAKE OF YEZO MAIN INNER CRATER



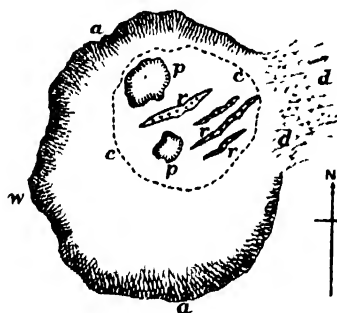
THE SHIRANESAN OF KUSATSU GENERAL VIEW OF THE CRATER AND LAKES.

westward, have caused a widening of the volcanic area into broad zones. It is in these broader zones of upheaval that activity is still displayed. Where the volcanoes form a narrow band, or a single chain, it has ceased.

The first of these zones is that of south-western Yezo, which almost completely surrounds Volcano bay. It contains the active craters of Noboribetsu and Usui on the north side, and Komagatake and Easan on the south, of this nearly circular inlet. Then, in Hondo, follows the mass of volcanic mountains surrounding Lake Inawashiro and continued southwards into the Nikko group. In this zone also are four active craters—Azumayama, Bandaisan, Nasuyama, and the Shiranesan of Yumoto (Nikko). The last of these zones, owing to its intersection by the subsequently opened Fuji-Oshima line, is the broadest. Here the peaks are both loftier and more numerous. Two large active craters remain—Asama in the centre line, and the Shiranesan of Kusatsu some 20 miles to the north. Some of these peaks are comparatively little known, and present features of interest which it is proposed here to illustrate.

1. THE KOMAGATAKE OF YEZO.

This is a comparatively ancient volcano, within which a considerable degree of activity on a small scale is still displayed. The old crater, distinguished from afar by the lofty peak in which its western wall culminates, has been breached on the north-east side. The three

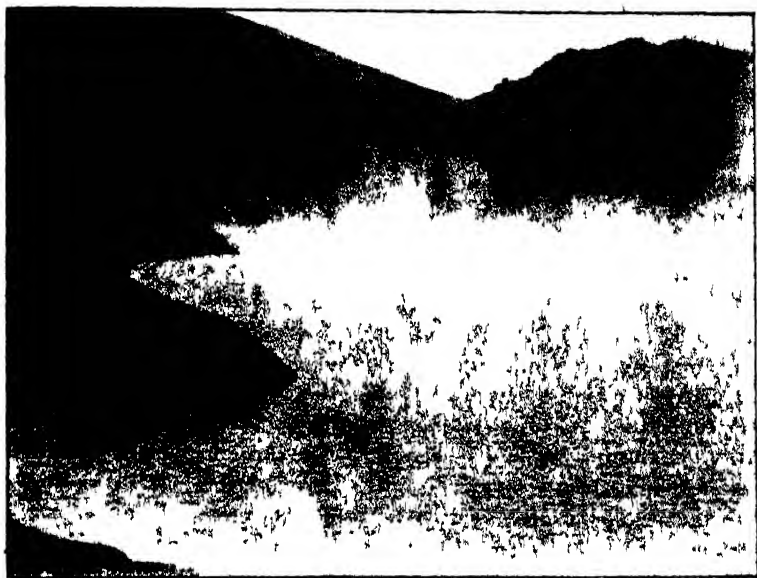


Plan of the Crater of Komagatake, Yezo.

a, a Ancient crater wall (the cross shading indicates rounded ridges). *d, d* debris of breach. *W* western pinnacle. *c, c* low inner cone. *p, p* pit craters. *r, r* parallel rifts with steam vents.

lakes (of which Onuma is the largest), formed at the base of the mountain by an eruption in comparatively recent times, are on the opposite (south-west) side. The ancient crater has a circumference of $1\frac{1}{2}$ mile, and a depth, below the western pinnacle, of 600 feet. Near the gap on the seaward side a new cone has been thrown up, broad and low. No mention of this new cone has been made either by Captain Bridgford or Prof.

Milne, who visited the spot in 1872 and 1877 respectively. The former (*Transactions of the Asiatic Society*, vol. 2, p. 80) speaks of six smaller craters, one of which was then active; the latter (*Transactions of the Seismological Society*, vol. 11 (a volume of 184 pages



SHIRANESAN THE CENTRAL LAKE, WEST SIDE



BLASTED TREES ON SHIRANESAN (CRATER IN THE DISTANCE)

describing 100 volcanoes), part 2) mentions only one small crater "with fissures running to it."

Changes may have taken place since then, probably in the course of a slight eruption which two summers ago covered the country-side to the east and north-east with a thin layer of ashes. The present configuration of the area within the low cone above mentioned is as follows (see plan):—(1) Circular pit-crater 40 yards in diameter and 30 to 40 feet deep, with low truncated cone in centre. The cone has no orifice, but is surrounded by a viscous mixture apparently of mud and sulphur, from which a little steam issues. (2) A deep narrow rift running east (towards the breach) containing five small vents discharging steam. (3) A smaller pit-crater, extinct. The rift lies between the two craters, and is joined further east by (4) several longer rifts which run parallel with the first on to the very flank of the cone, the last of the numerous vents steaming most vigorously. All recent eruptions of Komagatake, including that which resulted in the breaching of the ancient crater, have taken place in an easterly direction. The centre of activity appears, therefore, to be moving gradually eastward along these lines of fissure. The "lie" of these lines, precisely between Onuma and the breach, may not be without significance.

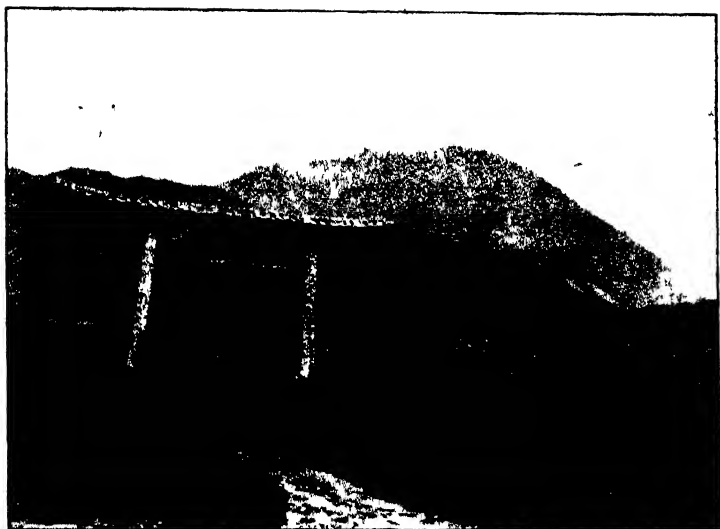
2. ESAN.

This volcano rises boldly from the north-east entrance of Tsugaru strait to a height of nearly 2000 feet. It is surrounded on three sides by the sea; and the crater, which is deep and finely formed, is breached on the side (west) away from the sea. By the gap thus made the crater can be entered. Steam and sulphurous vapours issue from many crevices in the precipitous and rocky walls of the crater, especially on the east or seaward side, imparting strange colours to the cliffs. The principal vent is centrally situated in the crater floor. It consists of a sharp-edged oval aperture, some 20 feet in its longest diameter. In the centre of it rises a sharp lava cone, apparently trachytic, its sides making an angle of 70° with the horizontal. From the eastern end of the vent a violent and continuous discharge of steam takes place, somewhat laterally, towards the central cone. The water of the stream flowing out of the crater of this volcano past some sulphur-diggers' huts contains free sulphuric acid.*

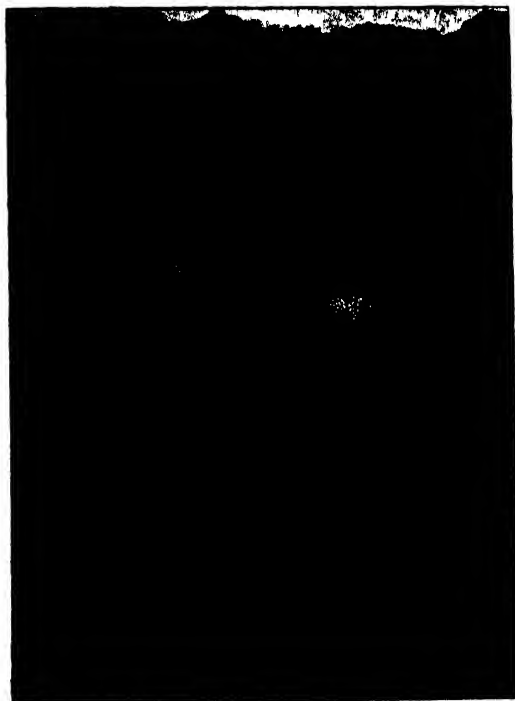
3. AZUMAYAMA.

This prominent peak rises from a sea of volcanic mountains to the north of Lake Inawashiro, within 10 miles of the famous Bandaisan,

* When Prof. Milne visited Esan in 1878, the weather was, he says, too foggy to see much. Consequently, by such statements as "the only evidences of true volcanic action were a few cinders embedded in the mud," justice is not done to this fine volcano



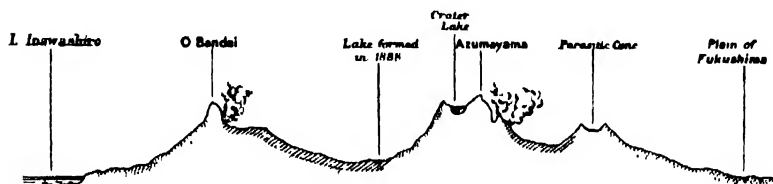
THE VOLCANO OF ESAN, FROM THE SOUTH.



THE CRATER OF ESAN, SHOWING CENTRAL VENT.

and 40 of Nasuyama, along the central axis of Hondo. These three volcanoes, long considered distinct, have broken out into destructive activity within the space of a dozen years (1893, 1888, 1881). Curiously enough, the chronological order of the outbreaks corresponds with the order of position. All three peaks are of about the same height (6000 feet)—suggesting, *ceteris paribus*, equality of age; and, their summit craters effectually sealed, all have broken out laterally on their flanks.

It is a noteworthy circumstance that with Bandaisan and Azumayama, as well as the Komagatake of Yezo, the explosions have taken place on the side opposite to the lakes formed at their respective bases (see diagrammatic section). Lake Inawashiro was in all probability the



Diagrammatic Section (N.E., S.S.W.) of Bandaisan and Azumayama

Vertical scale exaggerated 2½ times

--- Ancient Debris or Lava Flows. *ADUMMI* Recent

predisposing circumstance of the explosion on Bandaisan (1888). At that time three lakes came into being in the valley between it and Azumayama. In 1893 the latter, supposed extinct, burst into eruption on the north-east side.

The summit crater of Azuma is occupied by a lake a quarter of a mile in diameter. The sides are steep, and in places beautifully wooded. The wall crater rises to its highest in a bare rounded peak on the north side. The present active crater stands at about the same elevation as the lake. A vertical section would show the form of a fish-hook, with the barb outwards; a horizontal section would be an oval. The cliffs, terminating in a perpendicular rift on the upper side, have a height of 400 feet; the extreme width is about the same. The floor of the crater has two vents, now covered with mud. From the lower or eastern end a large quantity of steam is discharged with vigour. That the crater as a whole evolves a considerable degree of heat is evinced by the loud roaring which rises continually from it. A short distance below, the mountain is lined with solfataras, forming the termini of parallel fissures which run for some distance down the mountain-side. Strongly sulphurous vapours issue incessantly in great volume. The orifices, from 1 to 2 feet in diameter, are many of them half hidden by overhanging stalactites of

sulphur. The greater part, however, collects below in vivid yellow masses.

On the north-east side of Azumayama, at a height of about 4500 feet, there is a large parasitic cone with a well-formed crater, extinct, about a quarter of a mile in diameter. The angle of rest is approximately 30° .

4. BANDAI SAN.

The volcano of Bandaisan has already been the subject of much description, but none of the accounts published are perfectly consistent with one another. It is, moreover, impossible to ascertain with any precision the topographical features of the mountain group prior to the great explosion. It is generally admitted that the peaks (4) surrounding the level plain known as the *Numa-no-taira* formed part of an ancient crater ring which had been breached, and lay open to the north. The width of this ancient crater, from O-Bandai to the breach, was about a mile. Ko-Bandai, the destroyed mountain, occupied a position a little to the north of O-Bandai, and partly overlapping it. This suggests that the former was a parasitic cone of unusual dimensions, built up on the northern flank of O-Bandai after the great cataclysm which resulted in the formation of the crater ring. The previous breaching explosion had made a vast inclined plane leading from the edge of the ancient crater floor to the valley below, down which the broken fragments of Ko-Bandai, and the mud engendered by the immense quantities of steam, rushed with accelerated force. The photographs show the aspect of the devastated area in April, 1907. The hollow at the lower lip of the fracture was filled with snow, though the slope leading up from it was steaming from numerous small vents.

5. NASUYAMA.

This volcano, 6300 feet high, is remarkable for the uncommon disposition of its craters. For 500 feet down from its sharply peaked summit, the western side of the cone is riddled with active vents, great and small. Just below the summit lies the principal and original crater, some 200 feet in width, and marked from afar by a great cloud of steam. Immediately above the limit of vegetation (5700 feet), a mass of sulphurous vapour indicates the position of the second large vent. This is a sombre pit, some 80 feet in depth, with abrupt perpendicular walls, which passes under an arch of grey rock horizontally into the bowels of the mountain. The vapours from this crater are discharged with a hot blast laterally.

Between the two craters, a number of solfataras send forth their



BANDAISAN FROM LAKE MAWASHIRO.



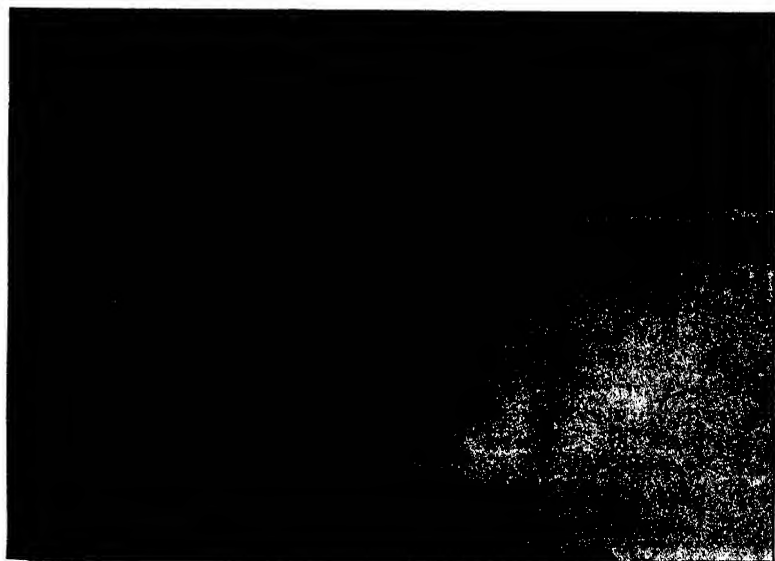
BANDAISAN. IN THE MIDST OF THE *DÉBRIS*, THE NEW BED OF THE NAGASE-GAWA.

suffocating vapours westward in great volume and with a deafening noise.

The waters of the hot springs on the mountain-side are strongly acid.



NASUYAMA : THE SUMMIT CRATER FROM THE SOUTH-WEST.



CRATER LAKE OF AZUMAYAMA.

No. II.—FEBRUARY, 1908.]

6. THE SHIRANESAN OF KUSATSU.

Three lakes, separated by narrow walls, occupy the great crater of the Shiranesan of Kusatsu. The sides of the cone, as well as the lake-basins, are composed of grey tuff and sulphur, which the abundant moisture keeps in a pasty state, and through which, in places, andesitic rock crops out in bold cliffs and pinnacles. As a whole, the crater is oval, but the lakes are circular. The total length of the crater is a little over half a mile. The central lake-basin, the water of which is boiling in the north-western part, is itself a quarter of a mile in diameter. A small stream flows from the south lake into the central one, but there is no such connection between the central and the northern, which occupies a slightly higher level.

All the lakes appear to be diminishing in size. At the time of the eruption of 1882, from which the present period of activity dates, the water of the central lake stood only 20 to 30 feet below the edge of the crater wall; it is now 100 feet below. For a full year after that eruption, a geyser-like activity was displayed, grey mud, boiling water, and stones being shot in a column to a height of 50 feet. A sulphur factory was then built near the edge of the crater wall, but was destroyed in a subsequent eruption, when the geyser again became active.

A feature of Shiranesan is its blasted trees, the work of the eruption of 1882. The noxious fumes given off on that occasion destroyed pines on neighbouring mountains at a distance of $2\frac{1}{2}$ miles from the crater.

A sample of water from the south lake (September, 1907), on being tested, showed no hydrochloric acid.* Sulphates of iron and, to a small extent, of aluminium were present, together with a considerable proportion of free sulphuric acid. The hot springs of Kusatsu, at the foot of the mountain, owe their efficacy to the presence of the same acid.

In conclusion, we may remark that along the whole line, from Yezo to Shiranesan, a general recrudescence of volcanic activity has taken place within the last twenty-five years; that the mountains in the Hondo portion of the line, with the exception of the Nikko group (which are a little higher), have an average elevation of 6500 feet approximately; that the majority of the craters have been breached, or have broken out laterally; and that this has occurred in several instances on the side remote from lakes formed at the base of the mountain in comparatively recent times. As pointed out by Prof. Milne, the rocks of the northern volcanoes are more acidic than those of the southern volcanoes, and this is borne out by the generally acid character of the hot springs issuing from them.

* The water of these lakes is said by the editors of Murray's 'Handbook to Japan' (p. 187), to consist of "hydrochloric acid, with iron and alum. . . ."

AN EARLY SIXTEENTH-CENTURY MAP OF THE WORLD.

A CURIOUS little map, dating from the second decade of the sixteenth century, has lately been obtained by Mr. H. Ruffer, a Fellow of our Society, through the well-known bookseller of Milan, Signor U. Hoepli. Its present owner having obligingly offered to bear the major portion of the expense of reproduction, we are enabled to give a facsimile in the present number of the *Journal*. Nothing appears to be known of the history of the map, which purports to be by Fra Michiel Barbolan, and to have been drawn at Venice in 1514. It bears the title 'Universal Orbe della Tera,' and though giving a very slight and general view of the then-known world, offers some points of interest. As in other maps of the period, produced on the more literary side of geography, it shows many traces of the Ptolemaic influence, and makes no attempt to lay down accurately the results of nautical discovery. But it may help to cast a side light on the diffusion of geographical ideas, and the genealogy, so to say, of cartographical documents, in the period then closing, in which Italy had occupied so distinguished a position, though no doubt many Italian productions in this field are now lost.

Of the four dozen names inserted in the map, most, it will be seen, represent countries rather than cities. The principle of selection is not very apparent, and in a slight sketch of the kind we should hardly have expected to find names like Finland, Riga, and La Rochelle. On the other hand, the names inserted for the more distant parts of the world show the author to have had some knowledge of the more important countries, and of centres of commerce like Aden and Malacca. Indications of his religious sympathies are to be seen in the representation of Jerusalem, in the coat-of-arms in the top left-hand corner, and possibly in the red cross of the ship sailing towards Hispaniola, which island seems singled out for special notice by being shown in gold. Mr. Ruffer suggests that Fra Barbolan may have been interested in missionary enterprise.

Among the maps with which it is natural to compare the present specimen are those of the Ptolemy of Rome (1508), Venice (1511), and Strassburg (1513), with others of Waldseemüller's productions comparable with the last-named. In one respect, at least, it shows an improvement on the more pretentious effort of Sylvanus in the 1511 Ptolemy (brought out in the same city only three years earlier), for there is a more correct presentation of the two Indian peninsulas, flanked by Ceylon and Sumatra, and with the name Malacca on the more easterly of the two, as in Ruysch's map in the Ptolemy of 1508 and in Waldseemüller's of 1513. In the name "Russia blanca" we have a further point of resemblance with the World-map of 1513,

* Map, p. 244. The scale of the original has been reduced by about one-fourth.

though in this the name is derived from an earlier map of *Italian* provenance—that of Martellus of 1489—from which (or from a common prototype) a large part of the 1513 map was closely copied (cf. *Journal*, vol. 23, p. 764). The original authority for the term seems to be the famous map of Fra Mauro (1459)—itself produced in Venice and probably known to Fra Barbolan—which shows not only “*Rossia bianca*,” but “*Rossia negra*” and “*Rossia rossa*,” explaining the terms as derived from the White sea and the Black and Red rivers.* The name “*Thebet*,” found in comparatively few maps of the time, had already appeared in Fra Mauro’s, who also located the islands of Ceylon and Sumatra (“*Taprobana*”) in correct relation to the two Indian peninsulas, showing here, as elsewhere, a knowledge much in advance of his time.

Although Fra Barbolan does not fill in the extreme east coast of Asia, it seems probable that this is due, as in Waldseemüller’s ‘*Carta Marina*’ of 1516, merely to want of space, and that the map really belongs to the type so much in vogue at the time, in which the continent is bounded eastward by a wide ocean, separating it from the New World, though the conception is marred by the retention of Ptolemy’s eastern coast of the *Sinus Magnus*, involving the strange excrescence to the south-east of the continent. It is possible, however, that the author was intentionally adopting a non-committal attitude on this question. Perhaps the most remarkable feature in the map is the junction of Europe with the New World by the extreme north, though this, after all, is an easy step, if a purely speculative one, from the many earlier maps in which Greenland was shown as a long narrow peninsula attached to North-West Europe. This feature seems another characteristic of Italian workmanship, pointing to the probability of the former existence of now-lost links in the chain of evolution. Thus it recurs again with equal definiteness more than thirty years later, in another Venice map—that of Gastaldi in the Ptolemy of 1548, while it seems to be hinted at in some, at least, of the maps of the Battista Agnese school.

As regards the American portion, the author displays unusual boldness, for the time, in piecing together the scattered fragments, from Labrador to Florida, into a continuous continental mass. He avoids the confusion as to the true character of Cuba displayed by so many of his contemporaries, including even Ruysch and Waldseemüller. In South America the use of the name Brazil forms another,

* It is curious that most of the later maps reproduce only the “*White Russia*,” though that in the ‘*Margarita Philosophica*’ of 1515 has also “*Russia rubra*.” The vitality of the term “*White Russia*” in the maps (especially Italian) of the sixteenth century is probably an instance of slavish copying by map-makers. It is found as late as 1566 in Gastaldi’s map of Russia, reproduced in Muller’s ‘*Remarkable Maps*.’

if an accidental, link with the work of the last-named, whose maps of 1515 and 1516 have hitherto been the earliest known specimens to adopt the new designation for the "Terra Sancte Crucis." But as Fra Barbolan's map is a year before the earlier of these, it may be that here again the Alsatian map-maker was drawing upon some Italian source.

REVIEWS.

ASIA.

ANCIENT KHOTAN.

'Ancient Khotan: Detailed Report of Archaeological Explorations in Chinese Turkestan.' Carried out and Described under the Orders of H.M. Indian Government by M. Aurel Stein, Indian Educational Service. Oxford: at the Clarendon Press. 1907.

WHEN, in the *Geographical Journal* of June, 1906, the scientific results of Dr. Sven Hedin's journey in Central Asia (1899-1902) were considered, the main point of physical interest was found to be the battle between water and sand—the latter from the east aggressive, and the former from the west defensive; whilst the issue, though fluctuating, appeared so far to have been favourable to the assailant. Cultivation and irrigation, there interdependent, have shrunk, and the desert has advanced. Cities, roads, and the rivers themselves have been obliterated, save when the wind has laid bare the ruins which the sand had first submerged and then preserved. So its action has not been solely destructive; indeed, to its protection Dr. M. A. Stein owes the materials for his detailed report of archaeological exploration in the neighbourhood of Khotan, and in what may be described as the south-western and southern part of the Takla Makan. Both of these explorers have published popular accounts of their journeys, followed by lengthy reports of results, the one book being more or less a complement of the other.

Dr. Stein's report, now under consideration, is dedicated to Sir Henry Yule, "the great elucidator of early travel and a pioneer in the historical geography of Central Asia," with a feeling of admiration and respect for that learned man which is highly commendable and is widely entertained. Its scope may be gathered from the title, whilst the region in which research was carried on was fixed, we are told, by "the important find of ancient birch-bark leaves, containing a Buddhist text in early Prākṛit and in Kharosthī writing, of which M. Dutreuil de Rhins had acquired a portion during his stay at Khotan." These fragments, on examination, were recognized as the oldest Indian manuscript then known, and the Government of India was induced to employ its agents to procure relics from Chinese Turkistan.

As usual, supply followed demand; but after much profound inquiry and deliberation by experts, doubt was cast on the finds, specially of manuscripts and block-prints obtained from treasure-seekers. That the suspicion was well founded it has been Dr. Stein's good fortune to establish; inquiry, semi-antiquarian, semi-judicial, held at Khotan, enabled him to clear up the mystery of these strange documents in unknown characters, which "not only figured conspicuously in the 'British Collection of Antiquities from Central Asia,' found at Calcutta, but had found their way also to public collections in London, Paris, St. Petersburg, and probably elsewhere." The forger, Islam Akhun, was at first shy and protested his innocence; he was merely an agent for certain persons at Khotan now dead, for the

sale of old books to purchasers in Kashgar; and he lamented, if there had been fraud, that he alone was left to bear the burden. His position was strong, but it was skillfully turned; the doctor was able to confront him with exact reproductions of the elaborate stories he had told, and partly delighted with the permanent record his inventions had obtained, and partly because he was assured that no punishment was contemplated, he eventually confessed and explained the plan he had followed to produce the article required by the sahibs. He was immensely impressed by the perfect photographic reproductions of his own handiwork, and at once grasped the idea that this art could be utilized with great success in the perpetration of further fraud; consequently, he prayed to be allowed to accompany the Doctor to Europe, where he might find a wider field for his peculiar talents.

But Dr. Stein not only exposed the false records, but may claim to have procured many genuine writings and relics which confirm what is known of the introduction of Buddhism from India, and demonstrate the influence of Indian language and art in these remote regions. His detailed report describes, perhaps too minutely, but with evident and scrupulous accuracy, how these were obtained; it may conveniently be divided into three main heads: the history of that part of Chinese Turkestan and its neighbouring countries; their geography; and descriptions of the ancient sites and the various relics discovered.

The history is extremely interesting, though often obscure, and much reading and study are required before a reasonably clear grasp of the subject is obtained. For we have to learn who the old inhabitants were, and who and what were their neighbours. Evidence seems to show that the people of Khotan are mainly of Arian stock, similar in most respects to the inhabitants of Wakhan and Sarikol, with an admixture of Turk and Tibetan blood. The Indian element was present before the introduction of Buddhism, and tradition points to Taxila as the source, with Gandhara and Kashmir as the routes of migration. The story is that King Asoka's eldest son, Kunāla, who was governor of Taxila, had his eyes put out by a wicked step-mother. When the news reached the king, his anger was so great that he banished all the principal inhabitants to Khotan, "a sandy desert to the north-east of the Snowy mountains." There the exiles established themselves, and elected a king, who laid the foundations of a city which became the capital of the kingdom. It had many vicissitudes, not always easy to trace; but, taken with Kashgar and the neighbouring countries, it may be said, in a general way, that Chinese influence and suzerainty prevailed, though interrupted for considerable periods, and that Buddhism was introduced about 120 A.D. The Huns, driven from China, their ancient and perhaps original seat, set forth westwards in two great divisions towards the Oxus and Volga. The first division "established their dominion in the fruitful and extensive plains of Sogdiana, on the eastern side of the Caspian, where they preserved the name of Huns, with the epithet of Euthaites, or Nephthalites." * These people, the White Huns, who arrived in the first century of our era, by the middle of the fifth ruled Eastern Turkistan, and had carried their conquests to Gandhara and the Indus. In turn they were overthrown by the Turks, called by the Chinese Tu-kiu, said to have come from the slopes of the Altai, where they were employed by the Khan of the Geougen in mining and smelting iron. Next the Saracens, about 710 A.D., bringing with them the religion of Mohammed, drove the Turks to the desert, occupied Transoxiana, and improved its commerce. "The mutual wants of India and Europe were supplied by the diligence of the Sogdian merchants, and the inestimable art of transforming

* Gibbon's 'Roman Empire,' chap. xxvi. These are the Hephthalites, Chinese I-ta, Yeh-tas whose original country was occupied by a tribe called Geougen.

linen into paper has been diffused from the manufactures of Samarcand over the Western world." *

Besides these changes there are the movements of the Scythians, Moguls, Tartars, and Turks, which culminated, so far as we are at present concerned, with the prosperous reign of Malik Shah, who crossed the Jaxartes and subjugated Turkistan, and the conquests in the thirteenth century, of Temugin, better known by his title of Chinghiz, Jingle, or Zingis Khan. His grandson was Kúblái, the Great Káán of whom Marco Polo has told us the story, and by whom the capital Cambaluc or Peking was built.

Marco Polo's description of Khotan, whose people, he records, "are subject to the Great Kaan, and are all worshippers of Mahomet," is still fairly correct. He says, "There are numerous towns and villages in the country, but Cotan, the capital, is the most noble of all, and gives its name to the kingdom. Everything is to be had there in plenty, including abundance of cotton. The people have vineyards and gardens and estates. They live by commerce and manufactures, and are no soldiers."† The more recent history of Khotan need not be detailed. The ancient capital, where Yotkan now stands, was abandoned, presumably after the eleventh century, and the country has for the most part been subject to China, though there have been rebellions, that of Ya'kub Beg of Kashgar being the most recent.

The additions to our geographical knowledge of those regions are mainly the results of Surveyor Ram Singh's surveys of the country about the Karatash pass, Khanarik, in Kuen Lun, in the desert, and at the ruins. Dr. Stein gratefully acknowledges his services and the obligation he is under to the Department for providing an assistant so able and so willing.

Turning now to the last and most important part of the work—the search for relics—full descriptions are given in chap. iv. of investigations near Kashgar and Yarkand, in chaps. v. and viii. of those from Karghalik to Khotan, and in the Khotan oasis. The site of the ancient capital at Yotkan, and the excavation for treasure and relics carried on like mining operations, the soil being washed by the aid of a river, are well described, and the finds are duly figured in the plates (vol. 2). When marching to the Khotan oasis, Dr. Stein passed the remarkable Kaptar Mazar, or Shrine of the Pigeons, where thousands of the birds, perfectly tame, are maintained by the offerings of travellers and the proceeds of other endowments. There is, of course, a legend which is duly recorded, and the site is not remote (may be the same) from the "succession of small hills," formed by the burrowing of rats, mentioned by Hsuan-tsang. The rats were as big as hedgehogs, and daily marched out, following a rat chief who saved Khotan from an invasion of the Huns.

Then various sites eastwards towards Charchan as far as the Endere river were visited; of these the most prolific seem to have been Dandan Uilig; a site beyond the Niya river; and the Endere ruins. Besides art relics, documents in various characters on wood, leather, and paper were obtained. Some are Chinese, others Tibetan, but the greater number, we gather, are Kharosthi in script, Prakrit in dialect. Some progress in deciphering them has been made, but the process is still incomplete. They go to prove the use of an Indian language in the records which are not in Chinese, and reproductions will be found in the volume of plates. Of these there are in all one hundred and nineteen of great excellence; but the number of objects pictured—frescoes, sculptures, terra-cottas, panels, seals, etc.—vastly exceed that number.

* *Vide* chap. II.

† Yule's 'Marco Polo,' vol. 1, p. 188 (3rd edit.).

The energetic and thoroughly consistent manner in which Dr. Stein has set about his explorations and their record deserves warm acknowledgment, and must form matter of congratulation to the Government of India. Transliteration of native names, that terrible stumbling-block, is a matter of very considerable importance, seeing that through it correct pronunciation is attainable, which without it is practically impossible. The want of a sound and reliable system adds enormously to the labour of reading, except in the most perfunctory manner, and this might be saved by proper care in writing. The system adopted for Chinese words by Dr. Stein, which he owes to M. Chavannes, is presumably correct if French values to the letters be given; but it is such as to be misleading to an English reader. The well-known Buddhist monk, Hiuen Tsang, becomes Hsüan-tsung; Si-yu-ki, the Buddhist records translated by Beal, is printed Hsi-yü-chi; Chê-chü-chia, Karghalik, or a town which was near it, is pronounced (we gather from the French *Tcho-keou-kia*) Cho-kiu-kia; Kia-che (Chia-Shih) is presumably pronounced Kia-shi, and if so, Kia-che would seem to be transliterated half in English and half in French fashion. It is most confusing to substitute *ch* for *k*, *u* for *a* short, and *ch* for *sh* when attempting to render oriental words in the English language.

Dr. Stein is now engaged on farther research in the Takla Makan; he has got relics from ruins north and south of Lob-nor, and has sent them to Kashgar, but has himself followed the route towards China used by Hsüan-tsang and Marco Polo. In or about the ruined watch-towers he has found many Chinese documents, and, with the help of Rai Ram Singh, has added some useful survey work in the Nanshan range. Let us hope, when the report of this work is written, that either native names may be written in native character as well as in English, or that a good system of transliteration may be followed.

W. BROADFOOT.

CENTRAL ASIA.

'Durch Asien.' By Dr. K. Futterer (continued by Dr. Fritz Noetling). Vol. 2. 'Geologische Charakter-Bilder.' Erster Teil. Berlin: Dietrich Reimer. 1905.

The geological results of Dr. Futterer's journey across Central Asia in the year 1898 are to appear in three parts, of which this is the first. It includes the field notes on the earlier part of the expedition, and describes the author's traverses of the Alai mountains, portions of the Kuen Lun chain, the Tarim desert, and the desert of Gobi. Part of the ground has been described by Kuropatkin and Sven Hedin; but large collections were made, and there is reason to believe that much new information was obtained by Dr. Futterer. Unfortunately, illness prevented him from completing his account of these investigations, but the editing of this volume has been placed in the hands of Dr. Noetling. The second part will contain the remainder of the field notes, while the third will be devoted to special subjects—such as petrography and palæontology.

The field notes are given in the form of a journal, in which chemical and other data are incorporated, and are rendered more intelligible by geological maps and sections and many photographic plates. To the geologist they are of interest from two points of view. Much of the book consists of descriptions of the process of desert erosion, very strikingly exemplified in many of the districts traversed. In the Tarim and Gobi deserts thin sheets of loess, sand, and gravel cover wide areas, and the essential features of desert scenery are exhibited in great perfection. Many fine illustrations are given in this book, showing the effects of sand-sculpture on exposed rock surfaces. There is also a study of the orientation of "dreikanter," and some information on the chemistry of saline desert soils.

More than half of the route traversed was over ground covered by superficial

deposits of this character, and over loose and incoherent Tertiary rocks. In some parts of the desert, however, outcrops of older rocks occur, and in the mountain passes and higher valleys of the Alai and the eastern Kuen Lun ranges magnificent sections were exposed to view. The circumstances of the expedition often allowed too little time for a thorough examination, but much has been gleaned that is of lasting value. The mountain axes consist very largely of granite and other intrusive rocks, with gneisses and much altered schists of indeterminable age. They are well seen in the defiles of the Terek-dawan pass, which leads to Kashgar from the north-west, and in the spurs of the Kuen Lun mountains. Upon these rest unconformably sandstones, limestones, tuffs, and other rocks which represent the Devonian (the "Kuen Lun" transgression or unconformability). The Upper Carboniferous strata overlie the older rocks with another unconformability, and are the deposits of a second or "Tibetan" transgression. Mesozoic strata are also in evidence, particularly to the west of Kashgar; they include Jurassic and Cretaceous rocks, sometimes fossiliferous. The gaps in the succession are large, but at least three epochs of disturbance have affected this region. The main strikes, however, are very consistently east and east-north-east. Much of the Gobi desert consists of a plateau built up of the older rocks, with some of the early Tertiary Han-hai or Gobi formation, buried in recent desert sands and gravels.

When completed, this work will be a repository of information on some of the least-known portions of Inner Asia, and a lasting monument to the energy and skill of its author.

J. S. F.

AFRICA.

INNERMOST AFRICA.

'From the Niger to the Nile.' By Captain Boyd Alexander, Rifle Brigade. 2 vols. Edward Arnold. 1907. Price 36s.

This is a very noteworthy book, as is the journey it records. Indeed, from the point of view of geographical discovery, this may turn out to be the last of the great African journeys, or the last but one. There is one more great effort of African exploration, perhaps the most arduous and expensive of all, a journey that is said to be contemplated by an even more distinguished explorer than Captain Boyd Alexander; and this will be to traverse the continent from Swakin through Kordofan, Wadai, Tibesti, Air, Asawa, to Cape Blanco. All the other big or moderately big things have been done, and the great distinction has fallen to the lot of Captain Boyd Alexander and his companions (Claud Alexander, G. B. Gosling, P. A. Talbot, and José Lopes) of completely solving the mystery of Lake Chad. The reviewer, in enumerating those who shared in the work of this remarkable expedition—two of them, Captains G. B. Gosling and Claud Alexander, lost their lives and were buried, the latter in Bornu, and the former on the upper Wele; while Mr. P. A. Talbot returned to England from the banks of Lake Chad—has included the name of José Lopes amongst the "officers," following in this the author of the book. This young man (not quite correctly styled in the book a Portuguese) was a native of the Cape Verde islands, who, in his boyhood, entered the service of Captain Boyd Alexander, and accompanied him on his journeys to the West Coast of Africa. On this last wonderful tour of exploration through the very heart of Africa, José Lopes, according to his employer's account, played such a splendid part in resourcefulness, courage, and adroitness, that he may well be promoted to the commissioned ranks.

The chief point with which this expedition will be associated historically is the survey of Lake Chad. Chad was the first discovered (by Europeans) of all the

great African lakes. More than this, it was probably the first great African lake hinted at in human history. Stories of its existence found their way across the Sahara desert to the Greek and Latin geographers, while from A.D. 900 onwards Arabs brought to the Mediterranean world a definite description of this sheet of water, which seemed all the more wonderful to the white man because of its close juxtaposition with the Sahara desert. The first Europeans to see Lake Chad were Denham and Clapperton in 1823. Overweg, a German in British employ, made a rough survey of it in 1852. Barth and Nachtigal added somewhat to our knowledge of the countries round this sheet of water, but so far as actual survey work went, it was never entitled to more than a dotted outline until this last expedition undertaken by the two Alexanders and their companions, Gosling and Talbot.

Lake Chad was found by them to consist of two or perhaps three completely separate areas of open water, the largest on the north-west, the one next in size on the south-east, while a small irregular patch—almost a series of lakelets—lay between these two separate lakes. The interval between the north-west and south-east water-areas was filled up by a narrow edging of swamp, still more by an extent of reed banks and dried marsh which had almost become solid ground. The southernmost extension of Chad is a great reed-swamp, which is fed by the wide delta of the river Shari.*

A careful and a geographically important land survey was carried out by the expedition from Ibi on the river Benue northwards, eastwards, and again northwards to Kaddai on Lake Chad. But with the departure on other work of Mr. P. A. Talbot, the accurate survey work of the expedition came to an end, and thenceforth there are few additions to our geographical knowledge, except important details here and there as to the courses and navigability of the northern affluents of the Mubangi and of the Yei tributary of the Mountain Nile.

But the whole book in itself is one of the most magnificent additions to geographical knowledge that has been published within recent years. It is difficult to speak of its photographic illustrations without enthusiasm. They are so apposite, so interesting, absolutely unfaked, and exquisitely reproduced. The reviewer is tempted to cover many pages by the interesting deductions to be drawn from these photographs, some of which are even more important in the facts they reveal than has been immediately apparent to Captain Boyd Alexander. Viewed in the light of ethnological information, these photographs are truly remarkable. For the first time we are given clear, exact portraits of certain types of Fula. The reviewer cannot unhesitatingly endorse the opinions expressed as to the origin of the Fula by Mr. Morel (which opinions are adopted by Boyd Alexander); but it is clear that the Fula, though their language connections almost certainly lie with West Africa rather than with East, are obviously a half-and-half type between the Caucasian of the north and the negro of the south. Moreover, they remind one irresistibly (as Lugard pointed out) of the Bahima aristocracy of western Uganda, and these again of the Gala and even of the Egyptians. It is a remarkable fact that the dominant breed of cattle amongst the Fula peoples in West and in Central Africa is almost identical with the Ankole oxen of western Uganda, north Tanganyika, and portions of the Congo Free State, a breed always associated with a Hamitic type of aristocracy, and, of course, also known to us as the commonest breed of cattle in Ancient Egypt (*Bos aegyptiacus*). These cattle, together with the humped zebu type, are admirably illustrated in the work under review.

* *Chad, Chadda* (name for the Benue), *Chari, Kadr, Ngali, Shari, Nsari, Nsadi, Zaire*, are among the many variants of an old African root-word for big river or lake, which underlies all the modern language families in West Central Africa.

The once mysterious Budduma islanders of Lake Chad are depicted to us by a remarkable series of illustrations, and proved to be very Nilotic in physical type. A good deal of information, photographic and literary, is also given about another very little-known people, the Tubu of the regions north-east of Lake Chad. Bornu and the interesting negroid Arabs of the Lake Chad region are depicted as they have never been before, and so are the Tawareq and their Crusaders' armour. So, too, is much of the big game—Sassaby antelopes (it is not quite correct to call them hartebeests), water-buck, rhinoceroses (this is the first time the rhinoceros has been recorded *scientifically* from West Central Africa), giraffes, lions, hippo, the okapi, chimpanzee, and cheetah; besides the native breed of dogs (particularly interesting), domestic sheep, goats, and the afore-mentioned oxen. The tropical forests of the Mubangi basin, the acacias, papyrus, and reeds of Lake Chad, the lake-like width of the Mubangi river, the ugly monotony of the Shari plains, the park-like country between the Niger and the Benue, and the extraordinary villages of the Murchison mountains (built round great natural monuments of bare rock); all these constitute such a faithful yet diversified picture of the very heart of Africa, its men, beasts, mountains, rivers, lakes, marshes, and towns, as has rarely, if ever, been put before the stay-at-home public by any previous writer.

There are a few trifling errors in the spelling of native names (in the south more particularly), but it would be ungenerous to make any trivial criticisms.

In conclusion, I should like to draw attention to the remarkable exploration of the island of Fernando Pó made by Captain Boyd Alexander several years ago, and to the fact that he noticed a great physical resemblance between the Bube natives of that island and the Munshi tribe of the river Benue. I have recently noted a certain linguistic connection between the Bube and the semi-Bantu tribes to the north-east of the Cross river, which brings us very near to the land of the Michi, or Munshi. It is curious that, although this warlike cannibal tribe has been known to explorers since the late fifties, no traveller has as yet recorded its language. The vocabulary taken down by Koelle in 1851, at Sierra Leone, from a supposed Munshi (Tivi) slave, shows this language to be semi-Bantu in character.

The letterpress of Captain Boyd Alexander's book is on a par with its illustrations.

H. H. JOHNSTON.

NORTH AFRICA.

'Stanford's Compendium of Geography and Travel' (new issue). Africa. Vol. 1, North Africa. By A. H. Keane, LL.D., F.R.G.S. *Maps and Illustrations*. Second edition, revised. London: Edward Stanford. 1907. *Price 15s. net.*

This edition of Prof. Keane's volume on North Africa in 'Stanford's Compendium of Geography,' is intended for the student who seeks to possess in a convenient form the results of the additions made to geographical knowledge in that part of the world in the last twelve years, together with a summary of recent political and economic developments. The general character and high standard of the work is well known, and the first edition was a worthy contribution to a better understanding of many obscure and difficult problems. This new edition is a revision; the work has not been re-written, and while much has been added to bring the narrative "up-to-date," there are a few points open to criticism. This is especially the case with regard to British West Africa. Thus on p. 247, we read that the Gold Coast "is barred by the humiliating Anglo-French Treaty of August, 1880, from spreading inland beyond the 9th degree of north latitude"—whereas in fact it extends, in virtue of the 1898 Convention, to 11° N. lat. Then no hint is given of the recent gold-mining operations in the Gold Coast and Ashanti, while Kumasi is said (p. 381) to be "a large place with a reputed population of

70,000 to 100,000," whereas the true figure in December, 1906, was 6280, and, even including suburbs, did not exceed 20,000. Again, Lagos is credited with a population of 75,000, which is about 25,000 too many: it might have been pointed out that it is now capital of Southern Nigeria: Six lines are devoted to the work of the Royal Niger Company, and that without a mention of Sir George Goldie. Are not such phrases as "the still almost unknown region which is enclosed by the great northern bend of the Niger" (p. 267) and "Kasala, capital of the rich province of Taka" (p. 618), uncorrected survivals from the first edition? It is, however, an unthankful task to pursue these omissions and misstatements. The new issue retains all the wealth of ethnographic lore contained in the first edition, while the purely geographical pages have been, as a rule, adequately revised. The book is specially valuable as tracing the interrelation between the physical features of a country, the character of its inhabitants, and its economic development.

F. R. C.

AUSTRALASIA AND PACIFIC ISLANDS.

HISTORICAL GEOGRAPHY OF AUSTRALASIA.

'A Historical Geography of the British Colonies.' Edited by Sir Charles Lucas. Vol. 6, Australasia in two parts. By J. D. Rogers. Pp. 440, 9 maps. Oxford: 1907. Price 7s. 6d.

Into a volume of 440 pages Mr. J. D. Rogers has compressed a most instructive sketch of the political history and a summary of the geography of Australasia, under which term he includes, not only Australia and New Zealand, but most of the islands of the south-western Pacific. The volume is divided into two parts, of which the first (of 308 pages) deals with history, and the second (of 132 pages) with descriptive geography. The limits of space presented the author with the alternative of recounting only a few main events and stages, or of giving short reference to many. He has chosen the latter course, and deals so briefly with each episode that the volume is, for its size, a remarkably complete *précis* of Australian history. The book is saved from the dullness which usually accompanies such compression by its humour, its selection of graphic incidents, and a pithy and picturesque literary style. Thus the author remarks that the settlers of Otago and Christchurch were the only Australasians who were driven to colonization "bent on going to heaven in their own way without interruption" (p. 141), and gives a sarcastic sketch of Dr. Lang and his "indignation at the tardiness with which statesmen gave effect to what he and Providence had predetermined." The work shows on every page evidence of detailed research and reference to first-hand authorities. There are abundant quotations from the Colonial Hansards, and what is of even more value in this case, many references to early British official records, which are less accessible in Australia, where they are of most interest. The richness in reference to little-known official literature is the distinctive feature of this volume, which gives the book an authority and an interest out of all proportion to its size.

The main subject-matter is political history, but the author never writes as a partisan. He reminds us that the Australian wool trade grew from 1819 to 1844 with the help of a preferential tariff from Great Britain; and he adds that the effect of the abolition of this preference "cannot be traced with certainty by statisticians" (p. 90). The author writes with warm sympathy with his subject; he helps to repel the prejudice based on the introduction of the convicts by reference to the official statistics of their crimes; "more than half were criminals of the mildest type" (p. 53), and "many of the convicts of 1788 were not what we should call criminals" (p. 104). He quotes Leslie's statement that the twenty-two convicts

who accompanied him to the Darling Downs were "worth forty men I have since seen." The author obviously thinks the convicts were much better men than some of their gaolers, such as Governor Bligh—"that famous grim sea-captain," whose crew mutinied on the *Bounty*, and whose cleverness in stocking his private farm at the public expense "would have made the unjust steward green with envy" (p. 66). Luckily, Bligh ran a tilt against McArthur, "a man born to shine in many spheres of life, but not at the stake;" and a second mutiny against Bligh relieved Australia of this unscrupulous tyrant. It is a relief to turn from the early naval governors to statesmen like Gipps, who began his career by hanging seven white men who had slain blacks (p. 77), and Grey, who, when General Cameron declared Werarua was impregnable and demanded two thousand more soldiers, carried it by storm at the head of a few Colonial volunteers (p. 222). Mr. Rogers quotes Grey's noble maxim, "I could neither govern nor conciliate a people with whose languages, manners, customs, religion, and modes of thought I was unacquainted" (p. 139). The author does not seem to know Australia personally, and it is therefore remarkable how successfully he escapes the many pitfalls; there are occasional slips and misprints, such as the "verbestrate" New Guinea, the location of the Broken Hill mines at Silverton (p. 189) (although in part 2 the population of the two places is given correctly, and Silverton thus shown to be a mere hamlet), or the reference to the geysers of Mount Morgan. The statement, "Outrim is the only good coal district in Victoria" will please one company as much as it will be disapproved by the others. The author's view that Burke and Wills "were the first adventurers for adventure's sake in Australian history" is not likely to meet universal acceptance, nor his description of Eyre's great journey as a "mad freak." But it is ungracious to refer to such trifles when the whole historical section is so accurate and so fair.

The geographical section of the work is less satisfactory. The maps are poor and old fashioned; they represent widespread plateaus like mountain chains, and a barely perceptible divide on a broad plain as if it were a great mountain range. The account of the mountain system of New South Wales is interesting from its raciness of description, rather than as an accurate representation of its structure. The author's graphic methods are less suited to physical than to historical geography, and such passages as "the structure, shape, and direction of the great range contain the key which unlocks every geographical secret of Middle island. With the aid of this key, Middle island is read off as easily as Italy or South America" (pt. 2, p. 29), or that "All the gold of the east is quartz-gold, and the best gold is found where greenstone and slate are nearest, just as the best tin is found where granite meets slate" (p. 55), do not show the keen insight or accuracy of the historical part of the work. The author's knowledge of the geographical literature is also less complete than of the historical; acquaintance with Marshall's 'Geography of New Zealand' (1905) would have been useful in the description of New Zealand.

Probably the best chapter dealing with physical geography is that on the aborigines of Australia; the author brings out their Caucasian affinities by reference to their resemblance to the Dravidians of India and the Veddahs of Ceylon, and to the possibility of mistaking them for a "nude, scarred, dyed European." He lays stress on "the great gulf fixed" between the Australians and the black, woolly-haired Tasmanians. The author, however, describes subcision as an "objectless operation," a view in opposition to the expert medical opinion of Prof. Anderson Stuart. The author is to be congratulated on a compact and most useful digest of Australasian history.

POLAR REGIONS.

VOYAGE TO EAST GREENLAND.

'Duc d'Orléans. A travers la Banquise du Spitzberg au Cap Philippe, Mai-Août, 1905.' Paris: Librairie Plon. 1907. Pp. 349. *Maps and Illustrations. Price 24 francs.*

In 1905 the Duke of Orleans chartered the *Belgica*, and, with Captain A. de Gerlache in command, sailed for Spitzbergen. The vessel cruised along the western and northern coasts of West Spitzbergen, Dane's island and Treurenberg bay, the site of the Swedish geodetic station, being visited, and then an attempt was made from the north-western angle of Spitzbergen to reach the coast of Greenland, the chief object of the expedition; but the pack proved too solid, and, though a more westerly course was held than on previous voyages, Cape Bismarck was the first land sighted. The season proved to be unusually favourable, and open water lay to the north. A large bay—Orléans bay—was discovered, with an island, named Ile de France, on its eastern side. The duke tried to reach the western shore, but was stopped by lanes of water too wide and deep to cross without a boat. A lofty coast-line was also seen for a considerable distance to the north, and in all the duke claims to have added nearly 2° of latitude to the discovered shores of Greenland. Fuller details will be found in the *Geographical Journal*, vol. 29, pp. 93. For the rest, the narrative necessarily resembles those of the many polar expeditions which have gone out in recent years. Bears and hooded seals were numerous, and sport was good. The appendices contain the list of soundings and of birds and animals observed, and the book is well illustrated by the artist of the expedition, Mr. E. Mérite, and with photographs. The maps show the course of the whole voyage, the route along the edge of the pack and the newly discovered coast.

GENERAL.

A PIONEER OF THE SEA-ROUTE TO SIBERIA.

'Life and Voyages of Joseph Wiggins, F.R.G.S.' By Henry Johnson. London: Murray. 1907. *Price 15s. net.*

It is well that the praiseworthy efforts of Joseph Wiggins should be placed on permanent record. He was an excellent type of a British seaman, honest, knowing his business well, energetic, and persevering.

He was a master mariner, and in 1867 was appointed nautical examiner at Sunderland. While so employed he conceived the idea of establishing commercial intercourse with Siberia by way of the Kara sea. Siberia, he maintained, needed an ocean highway.

This is the old route attempted by Willoughby under the auspices of Edward VI., by Stephen Burrough, who discovered the strait, which ought to bear his name, between Novaya Zemlya and Vaigats island in 1556, by Pet and Jackman in 1580, and by Barents in 1594. All were stopped by the ice because they were too early in the season. But the Russian *lodias* even then made regu'lar voyages along the coast from Archangel to the river Obi. In 1738, Lieut. Malygin was sent by the Russian Government and reached the Obi, and Lieut. Kookalof made a voyage to the Yenisei. Admiral Lutke made surveys in 1821-24; and the coast-lines were delineated by Lieuts. Ivanoff and Ragosia in 1827-28. Later, in 1869, Palliser and Carlsen crossed the Kara sea to the mouth of the Obi, and in 1870 that sea was traversed by a whole fleet of Norwegian walrus-hunters, one of them, Johannesen, passing beyond the mouth of the Yenisei, finding the sea clear of ice late in the season.

All this was well known to us, and there was no question about the navigability

of the Kara sea. It is a shallow gulf, 320 miles long and 160 across. Ice-floes of great thickness are forced against the eastern shores of Novaya Zemlya, but the sea usually becomes navigable late in the season. The water is much colder than that of the Barents sea, and Von Baer called the Kara sea an ice-cellar. So that Captain Wiggins's theory about the Gulf Stream is mistaken.

Captain Wiggins discovered nothing. His merit is that he directed attention to this route to Siberia, and made himself a pilot for it. Siberian merchants, notably Sideroff and Siberiakoff, offered rewards for a successful voyage, and Captain Wiggins succeeded in raising funds to buy and fit out the steamer *Diana* (103 tons) in 1874. He was able to reach the mouth of the Obi, and then returned. But Nordenskiöld reached the Yenisei in 1875, and made an equally successful voyage in the following year.

In 1876, with the help of Mr. Gardiner and of Siberiakoff, Captain Wiggins was enabled to fit out the *Thames*, a steamer of 150 tons, and succeeded in reaching the Yenisei river; but there the *Thames* was wrecked and abandoned. It was in 1878 that Captain Wiggins made his most satisfactory voyage, through the very efficient aid of Mr. Oswald Cattley, a merchant of St. Petersburg. Mr. Cattley chartered the *Warhworth* steamer, and had a cargo of wheat and hemp ready in the Obi river. Captain Wiggins took out the *Warhworth* to the Obi, shipped the cargo, and returned without accident. The *Neptune*, a Hamburg steamer, did the same.

Sir Robert Morier, the English Ambassador at St. Petersburg, took up the cause with some enthusiasm in 1887, and a company was formed, owning the *Phoenix* steamer (270 tons). Captain Wiggins took her up the Yenisei, but there again his vessel was hopelessly stranded. Going home overland, he next went out in the *Labrador*, but returned with the cargo, and the company became bankrupt. From 1890 to 1894 Captain Wiggins was connected with Mr. Popham's ventures, reaching the Yenisei twice, but again losing his vessel.

It was necessary that there should have been complete success attending every voyage if commerce was to be turned into this channel. The only really well-managed venture was that of Mr. Cattley—a man who evidently understood his job. The Russian Government prefers to favour the Moscow merchants by turning all the trade into the railroad. But a time must come when Siberia will be free and the ocean highway by the Kara sea will naturally become a frequented and flourishing route.

After his last voyage to the Kara sea, Captain Wiggins commanded steamers bound to Australia. He finally retired to a house near Harrowgate, whence he volunteered to join the Antarctic search expedition. He died, at the age of seventy-three, on September 13, 1905. Captain Wiggins bequeathed the beautiful plate which had been presented to him by the Emperor of Russia, to the Royal Geographical Society.

In 1894 the Murchison Grant of our Society was presented to Captain Wiggins. The present writer then addressed him as follows: "It was through your resolution, determination, and excellent seamanlike qualities that a new route has been opened for commerce; you are the pilot of the Kara sea, and I understand that you have received a recognition of your services from his Imperial Majesty the Emperor of Russia. I am sure no man ever deserved it better. The Murchison Grant is in a peculiar way fitted for the recognition of your services, for Sir Roderick Murchison took the deepest interest in ice-navigation, as well as in the commercial prosperity of Russia."

This book is interesting and well arranged; but the panegyric is too indiscriminate. No man ever lived who never made any mistakes. There is also a

disposition to disparage the work of others, especially that of Nordenskiöld, who had certainly reached the Yenisei twice before Wiggins had reached it once. Wiggins was an exceedingly fine type of an English sailor, combining patience and forethought with energy and enthusiasm. He had an honesty of purpose and a charm of manner which secured him many friends.

C. R. M.

SHORT NOTICES.

Europe.—‘A History of the Parish of St. Mary, Rotherhithe.’ By E. J. Beck. (Cambridge: The University Press. 1907. Pp. xvi. and 270. *Maps and Illustrations*.) This detailed study, from original sources, of a district historically one of the most interesting in London, is excellently carried out and beautifully illustrated by means of a variety of appropriate reproductions, from old prints to works of Whistler, as well as by photographs. A chapter by Canon T. G. Bonney, based on the geological history of the district, form a fitting geographical preface.

‘The Spanish Series.’ By A. F. Calvert. (London: John Lane. 1907.) Three volumes of this series are here to be noticed—‘Toledo’ (pp. xxiii., 169, and 511 plates); ‘Granada and the Alhambra’ (new edition, pp. xxxvi., 88, and 460 plates); ‘Cordova’ (in which Mr. Calvert’s collaborator is Walter M. Gallichan, pp. xvi., 108, and 159 plates). As will be gathered from the above enumeration, the remarkable feature of these volumes is the number of illustrations. Considering their low price, these are very excellent. They provide an abundance of detail in architecture, paintings, and other objects of art, and though there are certain technical faults in some of the architectural photographs, not entirely, perhaps, to be accounted for by the difficulty of the subjects, criticism is silenced by the care shown in their selection. One plate in each volume is a sketch-map of the town treated.

Asia.—‘From Tokio through Manchuria with the Japanese.’ By Louis L. Seaman. (New York: Appleton. 1905. Pp. xv., 268. *Illustrations*.) This is an entertaining narrative of the author’s experiences and observations during the Russo-Japanese war, when he had special facilities for following affairs.

‘The Real Triumph of Japan.’ By Louis L. Seaman. (New York: Appleton. 1907. Pp. 292. *Illustrations*.) Here the same author deals with the particular subject in which he was primarily interested in connection with the Japanese operations, namely, their hospital and general medical organization, of which he is loud in praise.

‘The Sea-Dyaks of Borneo.’ By the Rev. E. H. Gomes. (London: Society for the Propagation of the Gospel in Foreign Parts. 1907. Pp. 75. *Maps and Illustrations*.) This little book provides a simple and clear account of an interesting people, not including much scientific ethnographical detail, but going deeply into the customs and mode of life of the Sea-Dyaks, and narrating the progress of missionary work among them. There are several excellent illustrations.

America.—‘A travers l’Amérique du Sud.’ By J. Delebecque. (Deuxième édition. Paris: Plon-Mourrit et Cie. 1907. Pp. viii. and 318. *Maps and Illustrations*.) The journey here described, includes coasting from La Guayra, in Venezuela, to Lima in Peru (crossing the Isthmus of Panama), with a *détour* into Ecuador, and finally the crossing of the continent by way of the Amazon. The time occupied in the crossing from Lima to Peru was sixty-four days. The story is told vividly, and with no little humour.

THE GEOGRAPHICAL ASSOCIATION.

THE Annual Meeting of the Geographical Association was held at University College, London, on Wednesday, January 8, 1908. The President, Mr. Douglas W. Freshfield, was in the chair. The hon. secretary, Mr. A. J. Herbertson, summarized the annual report. He pointed out the rapid growth of the Association, the membership of which had risen to 648, of whom fifty-six were colonial or foreign members. Three new branches had been opened in Sheffield, Bristol, and North London. The new edition of the 'Hints to Teachers,' originally prepared by Dr. Mill at the request of the Association, was in the Press, and would be issued with the title 'Guide to Geographical Books and Appliances' at Easter, by Messrs. G. Philip & Son. Dr. Mill had generously presented the Association with all his rights in the work. A special committee on lantern slides was preparing special sets illustrative of different regions and of different aspects of geography. Members would receive considerable discount on the prices of these slides, and could hire them for long periods at specially low rates. The committee had resolved to form a small lending library for the special benefit of country members. He asked for contributions to the lantern slides and library. The committee had arranged a course of six evening lectures on the Teaching of Geography, which would be given in the Lent term of 1908, at University College, London. The growing correspondence necessitated the appointment of new correspondents on different subjects. The reports of the branches showed that they were doing good work and proving of much local benefit. Special thanks had to be given to Mr. S. Vaughan Morgan for a donation of £10 to the general funds of the Association, and £5 5s. to the library funds. Donations in money, and presents of views and books, would be specially welcomed by the Association. Attention was called to the new regulations and syllabuses for training colleges and the certificate examinations, to the recognition of geography as a subject for the final pass B.A. at Oxford, and to the inclusion of geography, with 600 marks attached to it, among the subjects for the Higher Civil Service examinations.

The hon. treasurer, Mr. E. F. Elton, of Wellington College, then gave a statement of accounts. Both this and the annual report were adopted, and the office-bearers were elected for 1908.

Mr. Douglas W. Freshfield, who was re-elected President, then gave the presidential address. He said that last year he had had to comment on the exclusion of geography from the examinations for the higher branches of the Civil Service, including the Foreign Office. They could now congratulate themselves upon its inclusion. The struggle was a somewhat arduous one, and the President of the Royal Geographical Society (Sir G. Goldie) had spared no pains to bring it to a successful conclusion. They owed much to the support of the Universities; Oxford in particular. Members of the Foreign Office henceforth would not be called upon to pick up their geography, after they have joined it, at the expense of the interests of the nation. The minds of all engaged in secondary education had been lately agitated by the controversy with respect to the teaching of Greek in public schools and Universities. It affected teachers of geography inasmuch as some of those who desired to retain Greek in its old predominant position, would do so by throwing over wholly or in part such modern studies as history and geography; while, on the other hand, some of the modern extremists were led into revolutionary proposals which would injure the cultivation of a reasonable system in our public schools. There had lately been an interchange of articles in the *National Review* which might be cited in illustration of the present state of men's minds. That most popular author, lately a house master at Eton, Mr. Arthur Benson, alleged that classic

authors such as Caesar are studied far too laboriously and unintelligently—mainly as exercises in grammar—and he made the startling suggestion that a few hours every day might be spent with advantage by schoolboys in hearing the daily paper read and commented on. Canon Lyttelton, head master of Eton, retorted that “practical effectiveness” was missing in Mr. Benson’s criticism, that he had no scheme of education to put forward, and compared that criticism to the plaintive, inarticulate note of the curlew. But Canon Lyttelton went on to compare himself and his brother head masters to perplexed travellers on a misty moorland. Was not this an interesting confession from the first of head masters, and a suggestive one in the present crisis? In the light of this confession he glanced at the recent debates at the Head Masters’ Conference at Oxford, with the suggestion of the head masters of Winchester and Eton, that little boys at private schools should be soundly grounded in modern subjects in place of being crammed with Greek. Most of them would probably agree with this; but the boon was to be bought at a price. Canon Lyttelton was understood at the time to say that he proposed, in order to make more time for Greek, to exclude history and geography altogether from the teaching of boys between 12 and 18. He had, however, explained that he only meant to suggest as a detail that, in order to give time for a full study of Greek, modern studies should be neglected for two years. While the first supposed proposal was monstrous, the second was insidious and dangerous. He regarded the problem from the point of view of one who would deeply regret the exclusion of Greek, yet who could sympathize with the despair raised in masters’ minds by the multiplication of subjects, the absurdity of parents, and the diversity in intelligence of boys. Let classics be taught as modern languages were taught, and history and geography need not be excluded for two years; there would be plenty of time for keeping them up. If they were not kept up, the classics could not be taught properly. How could a book be read intelligently if the conditions, human and physical, in which the author moved were not explained? What confusions had not learned commentators and eminent editors fallen into from an incapacity to handle geographical and topographical facts? If geography and history were dropped even for two years, the geographical and historical aspects of classical teaching would be dropped, and the root of the subject would not be reached. Get rid of the tradition that the only intellectual grindstone for boys was to be found in the grammatical complexities of dead languages. Believe that languages could be taught with profit without aiming at the perfection of qualifying your pupils to write them with correct fluency in intricate metre. There was no need for permanent antagonism between the classicists and the moderns; the two “sides” could be combined and welded by those who would take a broad view, unhampered by traditions, party spirit; who would avoid the falsehood of extremes and the extravagances of cranks. Let them look abroad and see how other nations managed their education. Let them not be discouraged by the temporary bewilderment and divagations of their leaders. The latter would realize in time that while they had been meandering in mist the straight path was only a few yards off, and that other guideless parties had already found it.

Major C. F. Close delivered a lecture on “Map Projection” with lantern illustrations, and Mr. B. B. Dickinson, of Rugby, exhibited on the screen and described views of the Rhine gorge, specially prepared for members of the Association. A fuller report will be found in the *Geographical Teacher* for February.

THE MONTHLY RECORD.

EUROPE.

Glacial Lakes and River-gorges in England.—In the well-known case of the Yorkshire Derwent, it has been generally accepted by geologists that the gorge south of Malton was cut by the overflow of a lake which occupied the Vale of Pickering during the glacial epoch, such overflow being due to the blocking by ice of the natural outlet to the east. That a precisely similar state of things may have given rise to the formation of gorges in other parts of England is suggested by Mr. F. W. Harmer in a paper read before the Geological Society in May, 1907, and printed in the *Quarterly Journal* of that body for November. The writer avowedly dealt largely with hypothesis, and his views will not be accepted in their entirety without further evidence, but they are at least worthy of consideration as supplying an alternative explanation of the origin of some of the English river systems as at present existing. Mr. Harmer starts with the statement that the gorge-like valleys of Yorkshire, of which the glacial origin has been established, must be typical rather than anomalous, and that where we see similar recent-looking gorges cut down to base-level across ridges of high land, a similar origin is suggested, while he holds that the conditions in Central England in glacial times were precisely those under which glacial lakes would naturally have originated. The principal cases put forward are as follows: (1) The gorge of the Severn at Ironbridge, with a supposed lake occupying the southern part of the Cheshire plain; (2) the gorges at Stratford-on-Avon and Clifton, with a lake in the Trowbridge area; (3) the gaps in the Jurassic escarpment at Lincoln and Ancaster; (4) the Goring gap in the Thames valley, with a lake occupying the great Oxford plain. Mr. Harmer supports his view, particularly in the two last cases, by a careful survey of the distribution of glacial deposits in Central England, which he shows to be such as to point in the desired direction. In the case of the Severn his explanation certainly seems probable, and it harmonizes with the views held for some time by Prof. Lapworth. But he, perhaps, makes too much of the supposed similar origin of similar phenomena, which, if carried to extremes, would involve a glacial origin for all gorges draining wide basins across ridges of high ground, which can probably be explained, in many cases, by the differential denudation of the harder and softer formations. He also lays stress on the recent character of the gorges and the absence of indications of former river-courses, of which they might have formed part; though, considering the amount of possible subsequent denudation, such traces might hardly be expected to exist now. Another point insisted on is the fact that the gorges are cut down to the level of the plains on either side, though the precise bearing of this on the problem is not clearly explained. To account for the lowering of the plains above the gorges, Mr. Harmer resorts to what he terms "lacustrine denudation," which he supposes to have acted *pari passu* with the wearing down of the gorges. But he goes into no details as to its manner of action, and it could hardly, in any case, be as efficient as ordinary river erosion. His strongest point seems to be the very recent character of the gorges, and, in the case of the Goring gap, the presence in its immediate vicinity of high-level gravels regarded by competent observers as of Glacial age. The argument from the probability that the original drainage was longitudinal, following the strike of the Triassic and softer Jurassic rocks, also deserves consideration, though any attempt to define the conditions at so remote a period must involve a large element of uncertainty. In none of the cases spoken of is the direction of the former drainage so unequivocal as in that of the Vale of Pickering.

ASIA.

Dr. Sven Hedin.—A communication from Dr. Hedin, received at the Society, confirms the statements lately made in the daily press that the explorer claims to have located the ultimate sources of the Brahmaputra, Sutlej and Indus. That of the Brahmaputra (evidently the Kub of the previous communication: *Journal*, vol. 30, p. 560) is said to lie on the northern side of the northernmost parallel range of the Himalayas. On November 8 Dr. Hedin was about to start for Ladakh and Khotan.

Ascent of Mount Halcon, Mindoro.—This, the third highest summit in the Philippines, was ascended for the first time at the end of 1906 by an American party headed by Major E. A. Mearns, U.S. Army, and including among its members Mr. E. D. Merrill, who describes the expedition in the third number of the *Philippine Journal of Science* for 1907. The interior of Mindoro has remained the least known portion of the Philippine archipelago, its rough and forest-clad character presenting unusual difficulties to the explorer. The English naturalist, Mr. John Whitehead, reached an altitude of 6000 feet on the Mount Halcon range in 1895, while unsuccessful attempts to reach the summit were made by American parties in 1904 and in June, 1908. The difficulties are increased by the exceptionally heavy rainfall and the great body of water carried by the rivers when in flood. Dr. Mearns' expedition struck inland from Subaan, on the north coast to the west of Calapan, the capital of Mindoro, going south-west to the Alag river, an upper branch of the Bako, and ascending this to the vicinity of the mountain. Most of the route led over steep forest-clad ridges, between which the Alag and its tributaries flowed in deep cañons. Native trails were sometimes made use of, but a path had often to be cut through dense bush. On reaching an altitude of 4500 feet the travellers entered a region of constant fog and rain, and suffered severely from the constant wettings and the cold, the temperature being constantly below 60° Fahr. After attaining the main ridge at an altitude of 7800 feet, the bush gave way for a time to open heath lands, but these were limited in extent, and before gaining the summit the thickets became denser than ever (though more stunted), and the cutting of a path was excessively laborious. No indication was seen that man had ever penetrated to the summit region. The commissariat was naturally a matter of difficulty, especially as the advance party was more than once cut off from the base camp by flooded rivers, but in spite of all obstacles the return journey was at last successfully accomplished. Like other travellers, the expedition found leeches exceedingly troublesome at lower levels, but brown soap smeared on the legs of the native carriers was found to be a good repellent, and puttees proved effectual in the case of the whites. The interior of Mindoro is inhabited only by the aboriginal Mangyana, who are little known to the outside world. Their houses and clearings were frequently met with, but only three individuals were seen, as they take to flight on the approach of strangers. One of their houses was unusually large and well built. The presence of Mount Halcon (a Spanish name signifying "falcon," the natives apparently knowing the mountain either as Alag or Bako) causes an enormous precipitation in the north of Mindoro, extending continuously over nine months in the year, while the remaining three, February, March, and April, are not always dry. The vegetation bears evidence of the exceptional humidity in the abundance of epiphytes, ferns, orchids, mosses, etc., which at the higher elevations clothe the branches so densely as to completely conceal them. Halcon (which probably has an altitude of 8500 feet) is not due to volcanic action, but the range, which is formed of granite, white quartz, schist, and marble, seems to be a fold. Mindoro as a whole seems to differ from the rest of the group, of which it is possibly the oldest portion. There are indications of an early connection with some great mass to the west and south, followed by a prolonged separation.

AFRICA.

The Egyptian Survey Department.—The report of Captain Lyons for 1906 records the usual amount of valuable work in the various branches of this department, which has to do not only with survey pure and simple, but with meteorological and geological research, observations of the Nile discharge, and other matters. The two principal features of the survey work were the completion of the Cadastral Survey (on which a special report is promised), and the publication of about one-quarter of the general map of the Nile valley and delta on the scale of 1 : 50,000. Another piece of work was the demarcation of the Turco-Egyptian frontier (*Journal*, vol. 30, p. 89), which will also be dealt with in a special publication. As regards second-order triangulation, a complete chain of which (as shown in a sketch-map accompanying the report) exists from the Mediterranean to Wadi Halfa, attention was chiefly directed during the year to the delta, a great part of which had not been satisfactorily triangulated before. Base-measurements at Alexandria and Waked with the Jäderin apparatus gave remarkably accurate results. Various lines of precise levelling were also completed in the delta. A great part of the work of the topographical section was done in the Nile valley between Khartum and Wadi Halfa, in connection with possible sites of reservoirs (*Journal*, vol. 29, p. 332). Great care was taken to ensure accurate results, and the levelling gave interesting results as regards the varying slope of the river. An important statement is made regarding the longitude of stations in the Sudan, as adopted in Colonel Talbot's survey. This officer used the value $31^{\circ} 17' 13''\cdot 5$ east of Greenwich for the west transit room of Abassia observatory, which has since been found to be $4''\cdot 96$ too great. But the direction given in 1902 in the War Office list of latitudes and longitudes, that $5''$ must be subtracted from Colonel Talbot's longitudes, does not after all hold good, for the Nile valley triangulation has shown that the longitude of Colonel Talbot's point at Wadi Halfa, as determined telegraphically some years ago, is too small by $4''\cdot 07$. The two corrections thus, curiously enough, nearly neutralize each other, the ultimate correction being only $0''\cdot 89$. The most important work of the Geological Survey was that in the eastern desert between 22° and 26° N., carried out by Dr. J. Ball, Mr. Villiers Stuart, and others. This is the subject of a memoir, which will be referred to elsewhere.

The East African Rift-system.—Dr. Carl Uhlig, whose researches in East Africa have been frequently referred to in the *Journal*, has summed up the results of his observations regarding the East African rift-valley and associated fault-scarps, in the *Geographische Zeitschrift* for September, 1907. The portion of the system examined by Dr. Uhlig and his associates was that comprised between 2° and 4° south, and extending from a little north of the Magad or Natron lake to a little south of the Laua ya Mueri : and the morphological features of this section are described in full detail by the writer, who also discusses the many problems still unsolved with regard to the geological history. He brings out clearly the complex character of the series of scarps and depressions, and shows the need for further research before the problems alluded to can be regarded as solved. Although all the main features are of tectonic origin, there is great diversity in their age and present form in different parts of the area. In places the scarps are well marked and follow a regular direction, while at others they are so irregular that it is difficult to say what is their precise direction or whether they are to be traced at all ; and while frequently formed of recent volcanic materials, they occasionally consist of Archaean rocks. The volcanoes, too, seem to be of very various ages. It is to the north of the area in question that the rift-valley bears the well-marked character known to visitors to British

East Africa, and described by Prof. Gregory in his well-known book. But while the western scarp continues its regular course between 2° and 4°, that on the east loses its continuity and even seems to disappear altogether. So that Prof. Uhlig hesitates to recognize a "rift-valley" at all in this section, but speaks of the western line of heights as the "East African fault-scarp." Even on this side the ground rises in somewhat irregular steps, and the main scarp itself varies greatly in height, though it shows throughout the characters of extreme youth, its high cliffs being bordered in places by a talus of 100 feet only. West of it, and running considerably to the west of south, is a second escarpment, in which the primitive rock comes to light. It is due equally to tectonic agencies, but is of greater age, its forms showing much greater maturity. To this Dr. Uhlig gives the name "Songo scarp," from the district which it bounds to the east. In the latitude of the north end of the Magad is the volcano Sambu, which gives a wide prospect over the surrounding country, and is likewise older than the main scarp, as half of it has been carried down beneath the surface of the Magad. The main scarp is the most recent of all the similar features, for besides the Songo scarp and Sambu, the Nyarasa scarp and the "Winter" highland (so named from the Winter fund by which the expedition was supported) have also been broken through by it. The Engai volcano is, however, still more recent, being the youngest of all the volcanoes. Much in the geological history of the region still rests, however, on pure hypothesis. Dr. Uhlig regards it as very doubtful whether any connection can be traced between the rifts of this part of East Africa and that of Nyasa in the south.

The Forest of Mount Kenia.—A Colonial Office Report (Miscellaneous, No. 41) gives an interesting expert account by Mr. D. E. Hutchins, of the Kenia forest, which measures 287 miles long by 8 broad, and comprises one million acres of timber, forming a girdle between the heights of 6000 and 9000 feet round the slopes of the mountain. It is the tropical continuation of the forest found at sea-level on the south coast of Cape Colony, at 3000 feet above the sea in Natal, and at between 4000 and 6000 feet in the Transvaal. In its advance to the equator, the forest increases in number of species, a disadvantage in the Kenia forest more than compensated by its possession of cedar in the drier and Ibean camphor in the wetter region. Rubber was not found by Mr. Hutchins in paying quantity in the southern half of the forest inspected by him. The best portion of this, on the south-east slopes, was dense, with lofty trees, clear of undergrowth, and having a soil carpeted with dead leaves and humus. In the lower forest there are more but shorter trees. In the upper the trees suffer from wet, and the number of species declines at the higher levels. At 8500 feet timber practically yields the ground to bamboo, which thence ranges up to the base of the cliffs and rocks of the snowy peak. The western forest is drier; cedar, of easy natural regeneration, is the chief species; bamboo abounds, but only in patches. From his own observation and from report, Mr. Hutchins estimates the timber in the Kenia forest to average, roughly, 2300 cubic feet per acre. On the basis of an average value of 2½d. per cubic foot, the value of the timber would be therefore £23 per acre, or in all £23,000,000, the interest of which would exceed by £100,000 the total expenditure of the East African Protectorate. The bamboo forest, over and above the timber, is estimated at 600,000 acres, but, in view of the more accessible bamboo elsewhere, is of little present importance. The rainfall is estimated at 80 to 120 inches on the south, and at 50 to 90 inches on the west side. On the latter, which is drier, forest fires have done incalculable mischief. A daily cloud gathers all over the Kenia slopes. During his stay in December and January, 1906-7, the climate was one of the most pleasant Mr. Hutchins ever experienced. Fevers are unknown, nor did he see or feel a mosquito. The report includes a

discussion of the question of a railway to Kenia, floating timber down the Tana, and the conditions for working the forest.

Northern Nigeria.—The annual report on this Protectorate for 1906-7, presented to Parliament in December last, is drawn up by Sir W. Wallace, who took over the temporary administration during a part of the interval between the departure of Sir F. Lugard and the arrival of his successor, Sir Percy Girouard. The year under review had been generally peaceful, the military operations having, apart from those against the troublesome Marghis in Bornu, been on quite a small scale. Apart from the Bassea province and certain pagan zones in the south, Mr. Wallace was able to report travel through the Protectorate to be absolutely safe. The special reports of the various residents tell a nearly uniform tale of progress, though in one or two provinces changes in the administrative *personnel* have been a drawback. From Bornu Mr. Hewby reports the Marghi and other tribes of the south and north-west as at last in hand. The Shehu (native ruler) is said to be probably the most loyal and one of the best emirs in the Protectorate. It had been decided to move the capital from Kuka to Maiduguri. Appended to Mr. Hewby's report is a short description of Lake Chad by Mr. Hanns Vischer, in which it is stated that the Bahr-el-Gazal to the east, with its continuation to the Bodele and Egei country, lies lower than the lake, and may be regarded as the outlet of its lagoons. This statement is hardly in agreement with the results of recent French research, for it was found by Captain Mangin (*Journal*, vol. 29, p. 569) that the underground flow is certainly towards the lake. In the Yola province, one of the outlying regions where trouble has sometimes been experienced, the attitude of the Fulani is said to be all that could be desired. There has been an influx of population from German territory, this movement being in the opposite direction to that in the previous year. Famine still continues to decimate some of the pagan tribes. Mr. Wallace has made further efforts to arrive at a more accurate estimate of the total population of the Protectorate, with the result that the number is now given as only a little over 7,000,000, of which total 2,714,000 falls to Kano province, and 920,000 to Bauchi. Reference is made to the recent decision to build a railway (ultimately, we believe, to be connected with the Southern Nigeria railway from Lagos), from Baro on the navigable Niger to Zaria and Kano, and it is thought that this will have an important influence on the development of the Protectorate. The steam flotilla numbered twelve vessels, including one twin-screw and ten stern-wheelers. A steel boat has been placed on the Yo, and a boat was also building for Lake Chad. Telegraph construction is still being pushed actively forward, 457 miles having been erected during the year, though more remains to be done. Work has been continued in connection with the mineral survey, and smelting has been commenced in the important tin-field in Bauchi, from which much is expected. Real progress seems to have been made as regards the introduction of cotton cultivation, and between February and December, 1906, 1847 bales, weighing 159 tons, had been ginned and shipped from Lokoja. An appendix treats of the present position of the Senusi movement, and though opinions seem to differ as to the danger to be apprehended from this, the general impression seems to be that British territory at least has little to fear in the near future. It is mentioned that a considerable exodus of nominal Mecca pilgrims has taken place both from the French Niger and from Bornu. The majority are said to be settling in the Nile valley.

Another Crossing of the Sahara.—Mr. Félix Dubois, well known for his work on Timbuktu, who went out early last year on behalf of the *Comité de l'Afrique Française* to make a general study of recent French work in the Sahara, has successfully crossed the desert to the Niger, which he reached about the beginning of December. He reports a state of complete security to prevail in the region traversed.

The Southern Territories of Algeria.—By a decree of April 10, 1907, some modification was introduced into the administrative division of the Algerian Sahara. To the former "territories" of Ain-Sefra, Ghardaia, and Tuggurt (depending respectively on the three older provinces) has been added that of "The Oases," with In Salah as capital. The surveillance of the Morocco frontier and of the Tuareg will thus fall in future to two distinct functionaries. The population of the whole area was estimated in 1906 as somewhat over 448,000. Sketch-maps illustrating the new arrangement are given in *A Travers le Monde* for November 2, and in the *Revue Francaise* for December, 1907.

AMERICA.

Who gave the Name to Labrador?—Dom Ernesto do Canto, in his pamphlet 'Quem deu o nome ao Labrador?' has given the most plausible explanation that has yet appeared. There was a certain João Fernandez settled on the island of Terceira, to whom King Manoel of Portugal gave a concession for the discovery of new lands in 1499. In other documents he is called João Fernandez *Labrador*. In those days *Labrador* did not necessarily mean a common labourer, but also a farmer or any one cultivating land. On March 19, 1501, Henry VII. granted letters patent to three Bristol merchants named Ward, Ashurst, and Thomas, with whom were associated three natives of the Azores, one of them being João Fernandez Labrador, to discover new lands. That they did discover new land is proved by Henry VII. having granted them a reward for having done so. Senhor Ernesto do Canto suggests that it was named Labrador by the Bristol merchants, after their colleague, João Fernandez Labrador.

The Huichol Indians of Mexico.—Following up his account of the Cora Indians, Herr K. Th. Preuss has communicated to *Globus* (vol. 92, Nos. 10 and 11) a report of his nine months' excursion, ending March, 1907, in the land of the Huichols in the Mexican Sierra Madre. The Cora to the north are divided from the Huichol Indians to the south by the Rio de Jesus Maria. Between the two, however, are some villages of the "vecinos," or Spanish-speaking Mexicans. The Huichol land, again, is divided in the middle from north to south by the Chapala-gana river, which, next turning west, empties into the Rio Jesus Maria, three days' journey above its junction with the Rio Grande. Politically in the state of Jalisco, the Huichol land is religiously administered by two vicars of the Josefinos Order in Zacatecas—one stationed at San Andres, the other at San Sebastian. Dealing principally with their religious notions and customs, the report yields a vivid insight into the naïve character of the Huichols. Knowing how to win their confidence, the author, on leaving, took away some sixteen hundred different objects illustrative of Huichol psychology. There are incidental notices of landscape. On a seven hours' ride over the mountain chain running north and south between San Isidro and Santa Gertrudis, not a ranch offered itself to view, not a human being, no corn-lands, everywhere only broad-leaved oak and tall pine. At the end Dr. Preuss lighted upon a twenty-hut ranch, Tierras Blancas, in the populous valley of Guastifa, the richest district of Huichol land. Here the festival of the roasting of the young corn-cobs was in full swing, following the festival of pumpkins and the cooking of the young cobs. Among other Huichol centres visited were Las Guasimas, Santa Gertrudis, Guadalupe Ocofan, San Andres, and Santa Catarina. The author had the fortune to find all these holding high festival, and was thus able to obtain a rich booty of songs and myths. The Huichol villages are properly occupied only during the festivals. The narrative brings out forcibly the way in which the Huichols have re-cast the institutions of the Christian Church after the pattern of their paganism, which still flourishes in its pristine vigour.

The Distribution of Population in South America.—A paper by Prof.

Mark Jefferson, reprinted from the *Bulletin* of the Geographical Society of Philadelphia, July, 1907, deals with the distribution of population in South America and the geographical factors influencing that distribution, the statistics being taken chiefly from the 'Statesman's Year Book.' The text is illustrated by maps and diagrams. The determining factor in the case of South America is not the rivers, though it boasts two of the greatest river systems of the world, but the mountains. The great bulk of the land lies within the tropics, and it is by the mountains that the dominant population climb to more temperate climates. The dense population of the north-west, including twenty-four cities of more than 5000 inhabitants each, lies along the high Andean valley at heights of 5000 to 13,000 feet. The dense population of Brazil (more than 26 to a square mile) equally clings to the high eastern border. The Amazonian Hinterland is abandoned to the aboriginal savages. The moderate peopling (8 to 26 per square mile) along the west and east coasts down to the southern tropic likewise holds to the mountains. A second factor of population is the coasts. The patches of dense population all lie within 400 miles of the sea. South of the tropics the Andes separate men no less than river-systems, dividing Chile and the Argentine, and not lying essentially in either. Towards the 40th parallel the population abruptly thins away, the blank being relieved only by the town of Punta Arenas. The plains of Chile and Argentina, enjoying a distinctive summer and winter, are the homes of thriving communities. Buenos Ayres with a million, and Rio de Janeiro with 700,000 inhabitants, are the two largest cities. It is notable how the smaller the provinces the more populous are they. The dense shade of population in the Andean republics follows the line of smallest subdivisions. The Amazonian provinces, on the other hand, are of the size of European kingdoms.

The Height of Aconcagua.—Although several attempts have been made to determine the height of the peak of Aconcagua, the culminating point of the Andes, since Admiral Fitzroy's observations in 1835, as is generally the case until an exact triangulation has been undertaken, the results have been most contradictory. In 1904 M. Fr. Schrader, the well-known French geographer, took advantage of an opportunity afforded him, when he had occasion to visit the region, to attempt a final settlement of this long-disputed question. The account of his method of measurement, with the final results, has only recently appeared (*Comptes Rendus Acad. Sciences Paris*, 29 Juillet, 1907), as he hoped to be able to visit the region a second time, but in this he has been disappointed. Owing to the impossibility of obtaining a suitable base by actual measurement at a known altitude from the ends of which the summit was visible, M. Schrader determined to follow the method suggested by Colonel Goulier, and obtain a base by tachometric measurement on the side of the mountain which was likely to be most reliable under the circumstances, and from the ends of this base take vertical and horizontal angles, from which the height could be computed to the summit of the peak. The levels of the Trans-Andine railway furnished a ready and reliable means of obtaining the height of the base, and as the observations were repeated and checked by various methods, the mean resulting height should not be far from the truth, and is probably the most accurate determination made up to the present date. The length of the base AB was 780.58 metres (2561 feet), and the height of the peak above sea-level, as obtained from vertical angles taken at A, was 6959.9 metres (22,832.07 feet), while from the other end, B, it was 6946 metres (22,789.19 feet). The mean of these two gives a final height of 6953 metres (22,812.1 feet), which result is only 56 feet lower than the height given by P. Güssfeldt, whose determination also depends upon vertical angles. At the commencement of his paper, M. Schrader alludes briefly to previous determinations

of the height of Aconcagua, commencing with Admiral Fitzroy, who surveyed the coast of this part of South America in 1835, but for some reason he entirely ignores the measurements of Mr. Lightbody, of Mr. E. A. Fitzgerald's expedition, 1896-97, which were described in the *Geographical Journal* for November, 1898, and the mean of which gives 23,080 feet for the height of the peak. Mr. Lightbody is an experienced surveyor, and, like M. Schrader, wisely decided to attempt some system of triangulation in preference to the more unreliable hypometrical determinations. Starting from Punta de la Vacas on the railway, which is fixed by levelling, he ran a theodolite traverse, with distances obtained by bar-subtense method, up the Horcones valley, vertical angles being taken to the summit of Aconcagua from different points on the traverse. As a good 6-inch theodolite was used for the measurement of the angles, the resulting height from the mean of the observations should not be far wrong, provided, of course, that the traverse was properly carried out, which seems to have been the case. It may also be pointed out that M. Schrader states that Admiral Fitzroy makes the height of Aconcagua to be 7300 metres (23,950·6 feet); but this appears to be a mistake, as 23,200 feet is the height given on the Admiralty chart drawn from this surveyor's observations in 1835, and the same figures are given in his paper in the *Proc. of the R.G.S.* for 1837, p. 143 (see also *Proc. of the R.G.S.*, vol. 19, p. lxxxvii). Admiral Beechey, who measured the height of this peak somewhat later, made it about 100 feet higher.

AUSTRALASIA AND PACIFIC ISLANDS.

The Murrumbidgee Water Conservation and Irrigation Scheme, recently sanctioned by the Australian Parliament, are the subject of a paper lately read by Dr. J. P. Thomson before the R.G.S. of Australasia, Queensland branch. The total length of the Murrumbidgee, from its source at the base of Peppercorn hill, 5000 feet above sea-level, to its union with the Murray at Balranald, is 1350 miles. From its source to Cooma bend, 170 miles, it has an average fall of 11 feet per mile. Thence to the Yass junction its average fall is 4 feet per mile. From Yass junction the Murrumbidgee, striking westerly, flows through the Riverina district, and is joined, below Hay, by the Lachlan, and, further down, unites with the Murray river. From Yass junction to Narrandera it has an average fall of 2 feet per mile. Thence to Murray junction, 470 miles, its average fall is 9 inches per mile. The Upper Region, or Barren Jack catchment, comprising the catchments of the river and its tributaries down to the junction of the Goodradigbee creek, has an area of 5000 square miles. The Middle Region includes the catchment area from Yass junction to Narrandera; the Lower Region, thence to Murray junction. The Upper Region, in which the great dam for the conservation of its waters is to be built, has the advantage of impermeable strata, an excellent climate, abundant rainfall, and is one of the best catchment areas in the state. Its rain-supply is supplemented by the periodic snowfall. The dam, to be erected at Barren Jack, 8 miles below the junction of the Murrumbidgee and Goodradigbee, is to be 200 feet high, and will have a reservoir capacity of 33,380,864,000 cubic feet, and a water area of no less than 20 square miles—an impounded area more than one and a half times that of a Sydney harbour, and a storage capacity little short of that of the Asuan barrage. The work, to be carried on without break from start to finish, is estimated to cost £810,000. Irrigation works are to be constructed in the Lower Region, which, with unusually high thermometer readings, has less than 20 inches rainfall. Between Narrandera and Hay are two large irrigable areas on either side the river. The Government Irrigation proposals are for the present, however, restricted to 858,000 acres (196,000 acres of which are first-class land). To divert the waters from the main channel to the service canals, a weir and regulator are to be

constructed at a granite bar near Bandigerry creek junction. From the offtake here the supply has to flow 132 miles—a course in which the minimization of loss by evaporation, soakage, etc., will be a problem of no little difficulty. Including weir and regulators, the estimated cost for service canals is £764,008, bringing up the total cost of the scheme to £1,574,008. The question of the irrigation of Australia, the paper points out, involves issues of immense economic importance. As a preliminary to all other operations, however, the writer urges the propriety of systematically gauging the rivers, exploring their basins, taking stock of their catchment areas, estimating the resources of ground water available, determining the amount of evaporation in each case, and locating suitable dam sites. The tank system of estimating evaporations, e.g., is criticized as obviously inadequate, and the official estimates of the volume of water passing Narrandera as far from conclusive. It is shown that, whereas in Italy, India, and America the sources of supply are practically inexhaustible, the coast rivers of Australia are short and rapid, while its inland streams carry very little water except in times of flood, nor in general are their channels suitable for large reservoirs.

POLAR REGIONS.

Captain Bénard's Arctic Expedition.—It has been known for some time that the French oceanographer, Captain Bénard, was organizing a scientific expedition to the Arctic seas, the idea of which first took definite shape at the time of the International Oceanographical Exhibition at Marseilles in 1905. An interview with the leader, reported in *Le Journal* for December 12 last, gives some details as to the progress of the preparations, which have so far advanced as to justify the hope that the expedition may be ready to sail in March of this year. A special vessel has been built, of the kind known to sailors as a ketch, strength being made an object throughout. It has been named the *Jaques Cartier*. M. Pénard has no intention of trying to make a record as regards latitude, but his object is to obtain accurate scientific observations from a little-known part of the Arctic region—the coasts of Novaya Zemlya, the Matochkin Shar, and the Kara sea. Work in the field of oceanography and maritime meteorology will be kept in the foreground, especial attention being devoted to the northern fisheries, with a view to the possible opening of new fields for French enterprise in this direction. The mineral resources of the lands visited will also be an object of study. The *personnel* of the expedition will number twenty, including, besides naval officers and seamen experienced in the Iceland fishery, a doctor, a naturalist, and a fur-hunter. Captain Bénard hopes to obtain a grant in aid of his fund from the French Government, a committee of the Institute having been appointed to report on the project.

Lieut. Shackleton's Expedition.—A Reuter telegram despatched from Lyttelton, New Zealand, on January 1, announced the departure for the Antarctic, at 5.30 p.m. on that day, of the *Nimrod*, Lieut. Shackleton's vessel, under tow by the *Koonya*, belonging to the Union Steamship Company of New Zealand. The voyagers received an enthusiastic send-off from the townspeople. A fortnight later the pack was reached, the *Koonya* then returning and bringing the leader's last messages before entering on the serious work of the expedition. The *Nimrod* is said to have behaved well in the gales experienced.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Earthquakes and Mountain-building.—It is no new idea that a close relation exists between earthquakes and the tectonic forces to which the great mountain ranges of the world owe their origin. But the precise nature of the relation has not, perhaps, been sufficiently worked out in detail, so that a

contribution to this side of the question, made by Prof. Frech in a recent number of *Petermanns Mitteilungen* (1907, No. 11), deserves some attention. The writer points out that no attempt had previously been made to show graphically on a map the geographical distribution of earthquakes side by side with that of the more recent and mobile, as contrasted with the older and more consolidated portions of the Earth's crust, and this omission he supplies in a map which accompanies his paper. The close agreement between the distribution of world-shaking earthquakes (for, like some other writers, Prof. Frech draws a more or less sharp line of distinction between these and the minor disturbances of a more local and less deep-seated character) and that of the great areas of Tertiary mountain-building, is thus forcibly brought out. In the paper itself, after tracing the general accordance between the two sets of phenomena, Prof. Frech discusses in detail the various regions of more recent tectonic activity, and shows the way in which the character of such action influences the distribution of earthquakes. Both the fractured block-ranges of the eastern Asiatic (or Pacific) type and the folded ranges of Alpine type are prolific of earthquakes, though there are differences in the mode of action in the two cases, the differential movement towards the vast depths of the Pacific being an important factor in the former. A consideration of the mountain ranges of Western North America, which partake of the nature of both types, leads to the conclusion that it is the age of the mountain-folding which especially determines the extent of seismicity, and that fracture and depression are of less importance than elevation and folding. Thus the recent folded ranges of Mexico are particularly subject to earthquakes. The oceans and the deep troughs in the neighbourhood of recent folded ranges, such as those lately brought to light in the Western Pacific, are important centres of disturbance, as are also the sites of sunken continental masses, as, *e.g.*, part of the North Atlantic and Indian oceans. As regards regions of continental fracture, the relative freedom from seismicity of the region of the East African rift is remarkable, though it may perhaps be explained by the relief to strain afforded here by volcanic action, in the immediate neighbourhood of which earthquakes do not, as a rule, occur. The older mountain chains, too, are little disturbed by earthquakes unless, as is the case in parts of Central and Western Asia, they are flanked on either side by newer folded ranges, to the influence of which they are thus subjected.

GENERAL.

Lectureship in Geography at Edinburgh University.—We learn with much pleasure that Mr. G. G. Chisholm, M.A., B.Sc., has been appointed Lecturer on Geography at Edinburgh University, where he will take up his new duties in October next.

The Late Sir Leopold M'Clintock.—In the obituary of Sir Leopold M'Clintock in the January number of the *Journal*, it should have been stated that the collection of fossils brought home by him was obtained from Mr. Olrik, the Inspector of North Greenland.

OBITUARY.

General Sir Frederic J. Goldsmid, K.C.S.I., C.B.

THE death of General Sir Frederic John Goldsmid removes a well-known member of the Royal Geographical and Royal Asiatic Societies, and serves once again to mark the passing changes which so rapidly and so surely are affecting our relations with the East. Sir Frederic joined the army in India in days when India was only just

reaching out for Imperial honours. Those were days when every young officer had a career before him if he was gifted with the spirit of enterprise and application. There could have been no Burton if there had been no unexplored Africa and Arabia. There could have been no Goldsmid had Europe and India been linked up by telegraph (as they will be by railway ere long), and had Baluchistan and Persia been open fields for the traveller in the middle of the last century. Doubtless Goldsmid owed much to his early training. Born at Milan in 1818, and educated in Paris and London, he had laid the foundation for that mastery of languages which so distinguished him before he turned his steps to the East. He entered the Madras army in 1839, and had earned the war medal for China before 1842, and within the next ten years he had passed as interpreter in Hindustani, Persian, and Arabic. In 1851 he was Assistant Adjutant-General of the Nagpur subsidiary force. At this period he took to a civil career, and was very soon on special political duty in Sind. That meant that he soon passed as interpreter in Sindi. In 1855 he joined the Turkish force on the military staff of Sir R. Vivian, and naturally passed in Turkish, and received the English and Turkish medals with a brevet majority. Again we find him on political duty in Sind under Sir Bartle Frere during the Mutiny, when he much distinguished himself in carrying out various risky missions and in dealing with the mutineers. As an indication of his all-round usefulness as a public servant, it may be recorded that he was Assistant Commissioner in the Political, Educational, and General, as well as the Revenue Departments of Bombay.

In 1861 he first became connected with the great scheme for linking up East and West by telegraph, with which his name has been so long and so honourably connected. He first laid the basis for telegraph construction by his mission to the chiefs of Baluchistan and Makran in that year; and in 1864 (after a period of comparative rest at home) he was associated with Colonel Patrick Stewart, R.E., in the laying of the Persian gulf cable. After an adventurous journey *via* Bagdad and Mosul to Constantinople, he was appointed Director-General of the Indo-European Telegraph on the death of Colonel Stewart in 1865, and at once proceeded *via* Russia to Tehran, to assist in negotiating the telegraph treaty. From Tehran he proceeded overland to India—a risky journey in those days—and from Simla he travelled to Europe, Tehran again, India, back again to England, and to France, to settle the terms of admission of the Indo-European telegraph into the general European system. Sir H. Yule computed that about this time he travelled 5700 miles in Persia and Baluchistan alone, with just the links necessary to take him to Bagdad on one side and Karachi on the other.

It was in 1870 that he was selected as commissioner to settle the Persian-Afghan frontier in Seistan, and incidentally that of the Perso-Baluch frontier also, and he travelled from England *via* Tehran to Ispahan and Kerman in the genial month of August for that purpose. It was a difficult and delicate task, and it was not until he had paid a second visit to Seistan that the thorny question was temporarily settled. Since Sir Frederic's arbitration two boundary commissions have again visited eastern Persia, the one to determine the Perso-Baluch frontier, and the other to readjust the Perso-Afghan line in Seistan. But no modern commission working in the old field has met with a tithe of the difficulty (chiefly arising from the shuffling diplomacy of Persia) that was encountered by Sir Frederic; and it is indeed a splendid testimony to his tact and ability that he was able to arrive at any result at all with such an unsatisfactory crew of determined procrastinators as were represented by the staff of the Persian commission. For this service Sir Frederic obtained the honour of Knight Commander of the Star of India. On January 1, 1875, Sir Frederic retired from active service with the rank of Major-General.

Since then he has served on various commissions (notably in Egypt during the war), and accepted an appointment as *Administrateur Délégué du Compte de l'Association Internationale*, "to carry out special measures for the organisation of the new Congo State." This journey up the Congo resulted in a severe illness, and he returned to London on December 31, 1893.

Sir F. Goldsmid was the author of 'Telegraph and Travel,' the biography of Sir James Outram, and many pamphlets, addresses, and reviews, published from time to time, separately, or in the Press and serials. He has besides edited and prefaced a work on 'Eastern Persia,' under the authority of the India Office. His knowledge of the Eastern languages placed him among the foremost of Oriental critics. He was a Vice-President of the Royal Geographical and Asiatic Societies, and in 1886 he was President of the Geographical section of the British Association at the Birmingham meeting.

Sir F. Goldsmid, in 1849, married the daughter of Lieutenant-General George Mackenzie Stuart, and had two sons and four daughters.

T. H. HOLDICH.

CORRESPONDENCE.

On the Influence of Ice-melting on Oceanic Circulation.

WITH reference to the remark of Dr. Otto Pettersson on the temperatures obtained by Sir John Ross in Baffin's bay in 1818 (see *Geog. Journal* for December, 1907, p. 174), I should like to draw Dr. Pettersson's attention to the fact that Sir J. Ross had in his vessel a pair of clammis, constructed under his own supervision, which brought up from the bottom, each time they were used, about 5 or 6 lbs. of mud, and that the temperature of the mud was taken on each occasion and found to agree with the temperature obtained by the self-registering thermometers. I think Ross's results, therefore, can hardly be attributed to imperfect instruments.

The instrument makers one hundred years ago were perfectly capable of constructing ordinary thermometers to give accurate results, and they appear to have supplied Ross with thermometers specially constructed to resist pressure, otherwise the results obtained would not have shown a steady decrease of temperature as the depth increased. Moreover, Sir Edward Sabine, who accompanied Ross in his expedition, informed Sir Wyville Thomson in 1870 that the thermometers were guarded in somewhat the same way as they are at present. The resulting temperatures, having been checked by observation of the temperature of the mud brought up from the bottom, cannot therefore be lightly thrown on one side as due to imperfect instruments.

T. H. TIZARD.

On North Polar Problems.

Washington, D.C., December 30, 1907.

Dr. Nansen's lecture, entitled "On North Polar Problems," published in the November and December numbers of the *Geographical Journal*, while criticising certain portions of my paper published in the Report of the Eighth International Geographic Congress, has failed to cover what I consider the two most significant items in that paper, viz.—

1. The fact that the flood at Point Barrow comes from the west, and not from the north or east, as Dr. Nansen's hypothesis necessitates.
2. The fact that the range of the tropic diurnal wave (especially on the Bering

strait side) is decidedly smaller than the range which would necessarily result from the action of the diurnal forces upon a deep basin of the dimensions he proposes.

In connection with these items, it should be borne in mind that the semi-daily tidal forces vanish at the pole, while the diurnal forces there have maximum values. Hence the semi-daily tide in the Arctic waters must be chiefly derived from the tide of the Atlantic, while a considerable diurnal tide would necessarily originate in a deep lake-like Arctic basin as extended as that pictured by Nansen. For illustration, the computed equilibrium tides at Duluth, Lake Superior, agree well with the observed values.

The fact that the (tropic) range of the diurnal wave is 0.5 foot at Point Barrow instead of 0.7 foot, as the forces require, proves conclusively that the dimensions of the deep Arctic basin are more contracted than Dr. Nansen has supposed.

It may be added that at every place where the diurnal tide has been ascertained from observation around the margin of this supposed basin, the ratio between the two principal constituents of the diurnal tide differs sensibly from that between the corresponding forces. This indicates that the lake-like deep basin is not sufficiently large for enabling the equilibrium diurnal tide to completely mask the small and irregular diurnal wave from the Atlantic. At Duluth, where equilibrium tides prevail, this tidal ratio agrees well with the force ratio.

In reply to Dr. Nansen's criticisms of my statements concerning certain currents, it may be said that in the first sentence of my paper I called attention to the fact that these currents are surface drift currents. I may have been misinformed in reference to the character of these currents as well as to that of the ice, for most of my conclusions were based upon statements to which references are given in my paper. In fact, Captain Mikkelsen's recent experience indicates that the west-going drift occurs north-eastward from Point Barrow, and it seems quite likely that it extends still further eastward. As counter-currents generally accompany drift-currents either as feeble currents below the surface or as lateral return currents, I fail to see where the distribution of land and water as outlined in my paper presents any necessary physical difficulties.

The east-going current north of Greenland, and the accelerated motion of the *Jeannette* during the last few weeks of her voyage, are mentioned in my paper, and certain inferences are there drawn from these facts.

Dr. Nansen says, "Mr. Harris does not, however, take up for discussion the difficult problem of the tidal phenomenon in the north polar sea," etc. In reply to this statement, I have only to say that results from all observations known to me to exist at the time of writing my paper were used in trying to ascertain the behaviour of the tide. There can be no reasonable doubt concerning the reliability of the observations at Point Barrow, Franz Josef Land, and Bennet Island.

I fear that my critic has not consulted the charts of cotidal lines which were constructed at the time when the paper to which he refers was written (see Fig. 23-26, Appendix No. 5, Coast and Geodetic Survey Report for 1904).

The semi-daily range of tide at Teplitz bay, Franz Josef Land, is 1.1 foot, and that at Bennet Island 2.0 feet. Of course, the shoaling around this island would tend to somewhat increase the range; but if the tide-wave were spread out over the supposed basin, it seems impossible that a range of 2 feet should occur at Bennet Island. Furthermore, the directions of the drift-arrows shown on Fig. 4 of Dr. Nansen's paper, at least, suggest comparative narrowness for the deep Arctic basin.

It is highly desirable to have information concerning the tides along the coast of Siberia, for it seems probable that the range would be much greater to the west of the New Siberian Islands than it would be to the east of them.

Up to the present time, no results from the tidal observations taken on the

recent Peary Expedition, or from those taken on the Mikkelsen-Leffingwell Expedition, have come to my knowledge. They will doubtless turn out to be of considerable importance in connection with north polar problems.

R. A. HARRIS.

The "Snake Kyaung" Monastery, Burma.

9, Windsor Road, Rangoon (Burma), 21-11-07.

I beg to inform you that I brought to the notice of the Chief Secretary to the Government of Burma the matter of the forgotten 'Snake Kyaung' referred to by Colonel Hobday in his review of the new book on 'Burma' by Sir George Scott, and published at pp. 432 and 433 of the *Geographical Journal* for October, 1907.

I have just received a reply from that officer to say, "Mr. Taw Sein Ko writes to say that the 'Snake Monastery' of Colonel Hobday has been identified as the 'Mogaung Kyaung,' and that a proposal for its conservation will be submitted in due course."

Mr. Taw Sein Ko, a Burmo-Chinese gentleman, who succeeded the late learned Dr. Forchhammer in the post, is the Government archaeologist in Burma.

J. C. CLANCEY.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907-1908.

Christmas Lecture, Friday, January 3, 1908.—"The Land of the Black Mountain, Montenegro, as I saw it." By the Rev. T. T. Norgate.

Christmas Lecture, Monday, January 6, 1908.—"Journeys through Lonely Labrador." By Mrs. Leonidas Hubbard.

Fifth Meeting, January 13, 1908.—Colonel G. Earl (Church in the Chair).

ELECTIONS.—*Captain Willoughby Furnwall, R.F.A.; Walter Meakin; Henry Frederick Merrill; Major Albert Pearse, R.A.M.C.; George Blount Tunstall-Moore; Harold Whitaker.*

The paper read was:—

"Among the Volcanoes of Guatemala and St. Vincent." By Dr. Tempest Anderson.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian, R.G.S.*

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Académie, Akademie.
Abh. = Abhandlungen.
Ann. = Annale, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Is. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.

Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mët.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selakab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidsskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 x 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

- Adriatic—Tide-levels.** *M. k.k. militär. J.* 26 (1906): 57-144. **Gregor.**
Die Höhe des Mittelwassers in Rogoznica, Zara, und Sestriec. Von Julius Gregor.
- Austria—Cartography.** *M. k.k. militär. J.* 26 (1906): 145-171. **Frank.**
Das Gerippe in den Kriegskarten. Von Otto Frank.
- Austria—Istria.** *G. Abhandlungen (Penck)* 9 (1907): No. 2, pp. iv and 166. **Krebs.**
Die Halbinsel Istrien. Landeskundliche Studie. Von Dr. Norbert Krebs. *With Maps and Illustrations.*
- Austria—Styria.** *Deutsche Erde* 6 (1907): 42-48. **Pfaundler.**
Die deutsch-slowenische Sprachgrenze in Steiermark. Von Dr. Richard Pfaundler. *With Map and Illustrations.*
- Austria—Triangulation.** **Hartenthurn.**
Die Tätigkeit des K. u. K. Militärgeographischen Institutes in den letzten 25 Jahren (1881 bis Ende 1905). Von Vincenz Haurdt von Hartenthurn. Wien, 1907. Size 9 x 6, pp. xviii and 612. *Maps. Presented by the Institute.*
- Baltic—Seiches.** *Beiträge zur Geophysik* 28 (1907): 367-399. **Doss.**
Ueber ostbaltische Nechären. Von Prof. Dr. Bruno Doss. *With Sketch-maps.*
- Europe—Anthropology.** **Arbo.**
Forhandl. Videnskabs-S., Christiania, 1906 (1907): No. 6, pp. 22.
De blonde Brachycephal og dens sandsynlige Udbredningsfelt. Af C. O. E. Arbo. *With Illustrations.*
- France—Hautes-Pyrénées.** *La G., B.S.G. Paris* 16 (1906): 1-18. **Eydoux and Maury.**
Les glaciers orientaux du Pic Long (Pyrénées centrales). Par D. Eydoux et L. Maury. *With Maps, Illustrations, and Diagrams.*
- France—Oise.** *Ann. G.* 16 (1907): 309-315. **Demangeon.**
La "Trouée de L'Oise." Par A. Demangeon. *With Maps.*
- Germany—Coasts.** *Ann. Hydrographie* 35 (1907): 289-296.
Die Eisverhältnisse an den deutschen Küsten im Winter 1906-07. *With Diagrams.*
- Italy—Venice.** **Douglas.**
Venice on foot; with the itinerary of the Grand Canal, and several direct routes to useful places. By Hugh A. Douglas. London: Methuen & Co., 1907. Size 7 x 4, pp. x. and 422. *Plans and Illustrations. Price 5s. net. Presented by the Publishers.* [See notice on p. 99, ante.]
- Italy—Vesuvius.** *Ann. G.* 16 (1907): 289-295. **Glaudeaud.**
L'Éruption du Vésuve en Avril 1906. Par Ph. Glaudeaud.
- Mediterranean—Tides.** *Ann. Hydrographie* 35 (1907): 356-371. **Wegemann.**
Beiträge zu den Gezeiten des Mittelländischen Meeres. Von Dr. G. Wegemann. *With Charts and Diagrams.*
- Norway—Coast.** **Hoel.**
Forhandl. Videnskabs-S., Christiania, 1906 (1907): No. 4, pp. 16.
Den marine Grænse ved Veltjorden. Af Adolph Hoel. *With Illustrations.*
Describes some newly discovered caves, and discusses their relation to old shore-lines.
- Norway—Coasts.**
Norway Pilot. Part I. From the Naze to Christiania; thence to the Kattegat. 4th edit. London: J. D. Potter, 1907. Size 9½ x 6, pp. xxx. and 510. *Index-chart. Price 3s. 6d. Presented by the Hydrographer of the Admiralty.*
- Norway—Glaciers.** **Oyen.**
Forhandl. Videnskabs-S., Christiania, 1906 (1907): No. 7, pp. 18.
Femten Aars glaciologiske Iagttagelser. Af P. A. Oyen.
- Norway and Sweden.** *B.S.R. Bolge G.* 31 (1907): 193-233. **Bihot.**
La rupture scandinave: étude anthropogéographique. Par Ch. Bihot.
- No. II. —FEBRUARY, 1908.]

Russia—Dnieper. *Annuaire géol. et miniers, Russie 8* (1906): 74-108. **Oppokof.**
Zur Frage über die Entstehungsweise und das Alter der Flussthäler in dem
Mittelgebiet des Dnieperbassins. Von E. Oppokow. [In Russian and German.]
With Sections.

Spain—Granada. **Calvert.**
Granada and the Alhambra: a brief description of the ancient city of Granada,
with a particular account of the Moorish palace. By Albert F. Calvert. London:
John Lane. Size 8 × 5, pp. xxxvi. and 90. *Plans and Illustrations.* Price
3s. 6d. net. *Presented by the Publisher.* [See notice on p. 212, ante.]

Switzerland—Pottery-clays. **Letsch and others.**
Die schweizerische Tonlager. Herausgegeben von der Schweiz Geotechnischen
Kommission. I. Geologischer Teil, von Dr. E. Letsch. II. Technologischer
Teil, von B. Zschokke; mit einer Beilage. . . von B. Zschokke und Dr. L.
Rohrer. III. Volkswirtschaftlicher Teil, von Dr. R. Moser. (*Beiträge zur Geo-
logie der Schweiz*, Geotechnischer Serie, iv Lieferung.) Bern, 1907. Size
12½ × 9½, pp. x., 431, 198, and 50. *Maps, Sections, and Illustrations*

United Kingdom
Memoirs of the Geological Survey. Summary of progress on the geological survey
of Great Britain and the Museum of Practical Geology for 1906. London. E.
Stanford, 1907. Size 10 × 6, pp. 182. *Illustrations. Maps in separate cover.*

United Kingdom—England. **Baker and Balch.**
The Netherworld of Mendip: explorations in the great caverns of Somerset, York-
shire, Derbyshire, and elsewhere. By Ernest A. Baker and Herbert A. Balch.
Clifton: J. Baker & Son, 1907. Size 9 × 6, pp. xii. and 172. *Sketch-map and
Illustrations.* Price 7s. 6d. net. *Presented by the Publishers.* [See p. 99, ante.]

United Kingdom—Scotland. **Wilkinson and others.**
Memoirs of the Geological Survey, Scotland. The explanation of Sheets 19 and
27, with the western part of sheet 20. The Geology of Islay, including Cronasay
and portions of Colonsay and Jura. By S. B. Wilkinson, with notes by J. J. H.
Teall and B. N. Peach. Glasgow: J. Hedderwick & Sons, 1907. Size 10 × 6,
pp. viii. and 82. *Sketch-map and Illustrations.* Price 2s. 6d. *Presented by the
Geological Survey*

ASIA.

Chinese Turkestan. *B. American G.S. 39* (1907): 268-272. **Huntington.**
Archæological discoveries in Chinese Turkestan. By Ellsworth Huntington.

Eastern Asia—Sakhalin. *J. Tōkyō G.S. 19* (1907): 285-301. **Jimbō.**
On the Orography and Geology of Karafuto. By Kotora Jimbō. [In Japanese.]

Eastern Asia—Sakhalin. *J. Tōkyō G.S. 19* (1907): 374-386. **Kawasaki.**
Coalfields of Karafuto. By Hantarō Kawasaki. *With Map.* [In Japanese.]

Eastern Asia—Sakhalin. *J. Tōkyō G.S. 19* (1907): 213-221. **Shiga.**
On the delimitation of the Japono-Russian Boundary in Karafuto. By Shigetaka
Shiga. [In Japanese.]

India—Bengal. *Mem. Asiatic S. Bengal 2* (1907): 43-84. **Bainbridge.**
The Saorias of the Rajmahal hills. By R. B. Bainbridge. *With Illustrations.*
The writer doubts the Dravidian affinities of these hillmen.

India—Irrigation. *J.S. Arts 55* (1907): 774-794. **Robertson.**
Irrigation Colonies in India. By Laurence Robertson. *With Diagrams.*

Indian Ocean—Seychelles. **Dupont.**
Report on a visit of investigation to St. Pierre, Astove, Cosmoledo, Assumption,
and the Aldabra group of the Seychelles islands. By B. Dupont. Seychelles,
1907. Size 13 × 8, pp. 52. *Maps. Presented by the Colonial Office.*
This will be dealt with in a special article.

Japan.
The Seventh Financial and Economic Annual of Japan, 1907. Tokyo: Govern-
ment Printing Office. Size 10½ × 7½, pp. vi., 196, and 30. *Map and Diagrams.*
Presented by the Minister of Finance, Tokyo.

- Japan—Asama-Yama.** *Sierra Club B. 6* (1907): 186-195. **Wieser.**
The Ascent of Asama-Yama. By the Rev. Prof. Edward A. Wieser. *With Illustrations.*
- Japan—Aso.** *Popular Sc. Monthly* 71 (1907): 29-49. **Anderson.**
The Great Japanese Volcano Aso. By Robert Anderson. *With Illustrations.*
 See monthly record, November, p. 560.
- Japan—Dalny.** ———
Trade of Tairen (Dalny) for the last seven months of the year 1906 By Mr. Vice-Consul H. G. Parlett. Foreign Office, Annual No. 3854. Size $9\frac{1}{2} \times 6$. pp. 12. *Price 1d.*
 The port was thrown open to foreign trade in September, 1906. within the period covered by this report. No inrush by foreign merchants had so far occurred.
- Japan—Structure.** *J. Tōkyō G.S.* 19 (1907): 92-117. **Ogawa.**
On the Geotectonic of South-West Japan By Takudzi Ogawa. [In Japanese.]
- Japan—Tides.** *J. Tōkyō G.S.* 19 (1907): 83-91. **Honda.**
The Tidal Current of Naruto. By Hōtarō Honda. *With Maps.* [In Japanese.]
- Malay Archipelago—Borneo.** **Gomes.**
The Sea-Dyaks of Borneo By the Rev. Edwin H. Gomes; with a chapter on missionary work amongst the Dyaks by the Ven. A. F. Sharp. London: Society for the Propagation of the Gospel, 1907. Size $7\frac{1}{2} \times 5$, pp. iv. and 7. *Map and Illustrations.* *Price 1s. net* Presented by the S.P.G. [See p. 212, ante.]
- Malay Archipelago—Hydrography.** *Ann. Hydrographic* 35 (1907): 296-305. ———
Ueber die Gezeiten in der Madura- und in der Soerabaja-Strasse, sowie Verbesserung der Tiefen im westlichen Teile der Soerabaja-Strasse. *With Diagrams.*
- Malay Archipelago—Java.** **Veth.**
Java: geographisch, ethnologisch, historisch. Door Prof. P. J. Veth. 2^e druk, bewerkt door Joh. F. Suellemann en J. F. Niemeijer. 4 vols. Haarlem: F. Bohn, 1896-1903. Size $10 \times 6\frac{1}{2}$, pp. (vol. 1) viii. and 396; (vol. 2) 438, (vol. 3) viii. and 602; (vol. 4) viii. and 579. *Maps and Portrait* Purchased.
- This edition of Veth's standard work has been thoroughly revised and brought up to date, the editors having begun their task so far back as 1895.
- Persia.** **Williams.**
Across Persia. By E. Crawshaw Williams. London: E. Arnold, 1907. Size $9 \times 5\frac{1}{2}$, pp. xii. and 348. *Map and Illustrations.* *Price 12s. 6d. net.* Presented by the Publisher [See notice at p. 100, ante.]
- Philippine Islands.** *Philippine J. Sc.* 2 (1907): 115-129. **Bacon.**
The crater lakes of Taal volcano. By Raymond Foss Bacon. *With Illustrations.*
- Philippine Islands.** *Philippine J. Sc.* 1 (1906): 1045-1058. **Smith.**
Contributions to the physiography of the Philippine Islands. By Warren D. Smith. I. Cebu Island. *With Illustrations.*
 See note in the monthly record.
- Russia—Kamchatka.** **Tuchoff.**
Mem. Imp. Russian G.S., General G. 37 (1906): No. 2, pp. xii. and 522.
Le long de la côte occidentale de Kamchatka. Par V. N. Tuchoff. *With Map.* [In Russian.]
- Russia—Siberia.** *Petersmanns M.* 53 (1907): 154-158. **Sibiriakof.**
Der Weg vom Fluase Kolyma zum Ochotakischen Meere und Oia als Seehafen für das Kolyma-Gebiet. Von A. Sibiriakow.
- Siam—Laos.** *B. Comité Asie française* 7 (1907): 268-294. **Lajonquière.**
Le Laos siamois. La vallée de la Se Moun: le monthon Nakhon Rachasi Ma (Korat), et le monthon Isan (Oubon). Par le commdt. L. de La Jonquière. *With Maps.*
- Western Asia.** *La G., B.S.G. Paris* 16 (1907): 67-70. **Lacoste.**
Autour de l'Afghanistan par le Karakorum et le petit Tibet. Par le Commdt. de Lacoste. *With Sketch-map.*

AFRICA.

- Africa.** *Fortnightly Rev.* (1907): 320-324. **Johnston.**
The disposal of Africa. By Sir H. H. Johnston.

Africa—British Protectorates.

The surveys of British Africa. The annual report of the Colonial Survey Committee. Second year, to July, 1907. (Colonial Reports, Annual No. 532.) London, 1907. Size $9\frac{1}{4} \times 6$, pp. 60. *Maps and Illustrations. Presented by the Colonial Office.*

Africa—Language.**Jacottet.**

Bantu phonetics. By Rev. E. Jacottet. (Supplement to *Christian Express*, September, 1907.) Lovedale, 1907. Size $13\frac{1}{4} \times 8\frac{1}{4}$, pp. 12.

See Review, *ante*, p. 91.

- Algeria—Economics.** *B. Comité Afrique Française* 17 (1907): 201-209. **Bernard.**

L'Outillage de l'Algérie. Par Augustin Bernard. *With Map*

- Cape Colony.** *Scottish G. Mag.* 23 (1907): 393-421 **Elliot.**

Notes and observations on an expedition in the western Cape Colony. By Lieut J. A. S. Elliot. *With Map and Illustrations.*

The route led from Carnarvon to Upington on the Orange river, and thence to Prieska.

- Central Africa—Botany.** *J. Linnean Soc. (Botany)* 38 (1907): 18-98. **Rendle.**

General report upon the Botanical results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunningham, 1904 and 1905. By Dr. A. B. Rendle.

Deals only with the higher plants collected from the three lakes visited; the fresh-water algae, which formed the bulk of the collections, being discussed in a separate paper. The former throw no light on the past relations of the lakes.

- Congo State.** *Mouvement G.* 24 (1907): 391-396 **Dausst.**

Le lac Leopold II. et ses affluents. Par Albert Dausst. *With Map*

- Congo State—Ethnology.** *B.S.R. Belg. G.* 31 (1907): 171-192, 234-251. **Harroy.**

Ethnographie congolaise les Bakubas. Par F. Harroy. *With Map and Illustrations.*

- Eritrea.** *Riv. G. Italiana* 14 (1907): 259-274 **Dainelli and Marinelli.**

Escursione al vulcano Alid (Colonie Eritrea). Appunti di G. Dainelli e O. Marinelli. *With Map.*

- German East Africa.** *Naturw. Wochenschrift* 22 (1907): 513-521, 529-536. **Schröder.**

Am Ostrande des Parahgebirges entlang zum Kilimandscharo. Von Dr. Christoph Schröder. *With Illustrations.*

- Madagascar.** *S. G. Com. Paris* 29 (1907): 369-393. **Geay.**

Aperçu sur les régions Sud de Madagascar. Par F. Geay.

Madagascar—Historical.**Grandidier.**

Collection des ouvrages anciens concernant Madagascar. Tome v. Ouvrages ou extraits d'ouvrages anglais, hollandais, portugais, espagnols, suédois et russes (1718-1800). Par Alfred Grandidier et Guillaume Grandidier. Paris: Comité de Madagascar, 1907. Size $10 \times 6\frac{1}{4}$, pp. 548. *Map and Facsimile Illustrations. Price 25s.*

This volume includes a number of minor pieces concerned with visits to or descriptions of Madagascar. The first portion deals with the doings of the pirates in the early part of the eighteenth century.

Nigeria—Northern.

Northern Nigeria. Correspondence relating to Sokoto, Hadejia, and the Munsin country. London, 1907. Size $13 \times 8\frac{1}{2}$, pp. vi. and 62. *Price 7d.*

Relates to disturbances during 1906.

Nile Basin.**Lyons.**

The rains of the Nile Basin and the Nile Flood of 1906. By Captain H. Lyons. (Survey Department paper, No. 2.) Cairo, 1907. Size $10\frac{1}{2} \times 7\frac{1}{2}$, pp. 70. *Maps and Diagrams.*

- Rhodesia.** *Smithsonian Misc. Coll.* 50 (No. 1703, 1907): 35-47. **Andrews.**

The "Webster" Ruin in Southern Rhodesia, Africa. By Edward M. Andrews. *With Illustrations.*

- Sahara—Ain-Salah.** *Ann. G.* 16 (1907): 337-349. **Métols.**
 Ain-Salah et ses dépendances. Par A. Métols. *With Map.*
- Sahara—Bilma.** *Rev. Coloniale* (1907): 361-386. **Gadel.**
 Notes sur Bilma et les oasis environnantes. Par Commandant Gadel.
- South Africa—Ethnology.** **Hall.**
 Notes on the traditions of South African races, especially of the Makalanga of Mashonaland. Being a reply, founded on Native traditions, to Prof. MacIver's conclusions as to the age of Great Zimbabwe. By R. N. Hall. (Reprinted from the *African Monthly*.) Grahamstown, 1907. Size $9\frac{1}{2} \times 6$, pp. 288-310.
 The writer argues that traditions of the building of Zimbabwe and other structures would have existed if they had been medieval in date.
- West Africa.** **Montmorres.**
 Liverpool University: Institute of Commercial Research in the Tropics. The commercial possibilities of West Africa. By Viscount Montmorres. Liverpool, 1907. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 24.

NORTH AMERICA

- Alaska—Malaspina Glacier.** *B. American G.S.* 39 (1907): 273-285. **Tarr.**
 The Malaspina Glacier. By Ralph S. Tarr. *With Map and Illustrations.*
 See note in vol. 29, p. 460.
- Alaska—Seward Peninsula.** *B.G.S. Philadelphia* 5 (1907): 10-20. **Smith.**
 Settlements and climate of the Seward Peninsula, Alaska. By Philip S. Smith. *With Sketch-map and Illustrations.*
- Alaska—Yakutat Bay** **Tarr.**
 Recent advance of glaciers in the Yakutat Bay region, Alaska. By Ralph S. Tarr. (*Bulletin of the Geological Society of America*, vol. 18, pp. 257-286.) New York, 1907. Size $10\frac{1}{2} \times 7$, pp. [30]. *Map and Illustrations Presented by the Author.*
 Cf. note in the *Journal* for April, 1907, p. 460.
- America—Ethnology.** **Friederici.**
 Die Schiffahrt der Indianer. Von Dr. Georg Friederici (Studien und Forschungen zur Menschen- und Völkerkunde, unter wissenschaftliche Leitung von Georg Buschm; 1.) Stuttgart: Strecker & Schroder, 1907. Size $9\frac{1}{2} \times 7$, pp. viii. and 130. *Illustrations. Price 1m. Presented by the Publishers.*
- Canada—British Columbia.**
 Annual report of the Minister of Mines for the year ending December 31, 1906, being an account of Mining Operations for Gold, Coal, etc., in the Province of British Columbia. Victoria, B.C., 1907. Size $10\frac{1}{2} \times 7$, pp. 276. *Map, Illustrations, and Tables. Presented by the Department of Mines, Victoria, B.C.*
- Canada—Rockies.** *Canadian Alpine J.* 1 (1907): 138-148. **Vaux.**
 Glacier observations. By George Vaux and William S. Vaux. *With Map and Illustrations.*
- Canada—Rockies.** *Canadian Alpine J.* 1 (1907): 149-158. **Wheeler.**
 Observations of the Yoho glacier. By A. O. Wheeler. *With Maps and Illustrations.*
- Mexico.** **Martin.**
 Mexico of the twentieth century. By Percy F. Martin. 2 vols. London: P. Arnold, 1907. Size $9 \times 5\frac{1}{2}$, pp. (vol. 1) xxiv. and 324; (vol. 2) xiv. and 330. *Map. Plan, and Illustrations. Price 30s. net Presented by the Publisher. [To be reviewed.]*
- Mexico.** **Diener.**
 Reise in das moderne Mexico: Erinnerungen an den x. Internationalen Geologenkongress in Mexico. Von Mietze Diener. Wien, etc.: A. Hartleben, 1908 [1907]. Size 9×6 , pp. 112. *Map and Illustrations. Price 3m. Presented by the Publisher.*
- Mexico—Ethnology.** **Lares.**
 Etnografía del estado Merida . . . Por Jose Ignacio Lares. Segunda edición. Mérida, 1907. Size $7\frac{1}{2} \times 5$, pp. 52.

Newfoundland.**Millais.**

Newfoundland and its untrodden ways. By J. G. Millais. London: Longmans, Green, & Co., 1907. Size $10\frac{1}{2} \times 7$, pp. xvi. and 340. *Maps and Illustrations.* Price 21s. net. Presented by the Publishers. [To be reviewed.]

Newfoundland, etc.

The Newfoundland and Labrador pilot, including the Strait of Belle Isle. 4th edit. London, 1907. Size $9\frac{1}{2} \times 6$, pp. xx. and 818. *Index-chart.*

North America.**Heaton.**

A scientific geography. IV. North America. By Ellis W. Heaton. London: Ralph, Holland, & Co., 1907. Size $7\frac{1}{2} \times 5$, pp. 130. *Sketch-maps and Diagrams.* Price 1s. 6d. net. Presented by the Publishers.

United States—Bighorn Mountains. *National G. Mag.* 18 (1907): 355-364. **Darton.**

Bighorn Mountains. By N. H. Darton. *With Map and Illustrations.*

United States—San Francisco. *Nineteenth Century* (1907): 220-227. **Davison.**

The San Francisco earthquake of 1906. By Charles Davison.

United States—Seismology.**McAdie.**

Smithsonian Miscellaneous Collections 49 (1907): No 1721, pp. 24.

Catalogue of earthquakes on the Pacific Coast, 1897 to 1906. By Alexander G. McAdie.

Compiled as a continuation of Prof. Holden's Catalogue, issued in 1898.

United States—Virginia. *B. American G.S.* 39 (1907): 285-291. **Surface.**

Racial and Regional Study of the Virginia population. By G. T. Surface.

United States—Virginia. *B. American G.S.* 39 (1907): 397-409. **Surface.**

Geographic influence on the economic history of Virginia. By G. T. Surface

CENTRAL AND SOUTH AMERICA.**Bolivia.**

Ann. G. 16 (1907): 350-359.

Dereims.

Le haut plateau de Bolivie. Par A. Dereims. *With Section and Illustrations.*

Brazil—Amazon**Craig.**

Recollections of an ill-fated expedition to the headwaters of the Madeira river in Brazil. By Neville B. Craig. Philadelphia and London: J. P. Lippincott Co., 1907. Size 9×6 , pp. 480. *Maps and Illustrations.* Price 18s. net. Presented by the Publishers. [To be reviewed.]

Brazil—Ethnology**Koeh-Grünberg**

Südamerikanische Felszeichnungen. Von Dr. Theodor Koeh-Grünberg. Berlin. Ernst Wasmuth, 1907. Size 11×7 , pp. iv. and 92. *Map and Illustrations.* Presented by the Publisher. [To be reviewed.]

Brazil—Historical. *Rev. I. Hist. e G. Brasileiro* 67 (1906): Part i, 243-387. —

Viagens no Brazil.

Apparently reproductions of early documents, but printed without any explanation or introductory matter.

Brazil—Para. *La G., B.S.G. Paris* 16 (1907): 19-26.**Ducke.**

Voyage au "campos" de l'Ariramba. Par A. Ducke.

Brazil—Parana.

Comissão Geografica e Geologica do Estado de S. Paulo. Exploração do Rio Paraná. I. Barra do Rio Tieté ao Rio Paranahyba. II. Barra do Rio Tieté ao Rio Parapanema. São Paulo, 1907. Size $17\frac{1}{2} \times 13$, pp. 24. *Maps and Illustrations.* Presented by the Commission.

British Guiana. *National G. Mag.* 18 (1907): 373-381.**Heilprin.**

An impression of the Guiana Wilderness. By Prof. Angelo Heilprin. *With Illustrations.*

Chile.**Elliot.**

Chile: its history and development, natural features, products, commerce, and present conditions. By G. F. Scott Elliot; with an introduction by Martin Hume. London: T. Fisher Unwin, 1907. Size 9×6 , pp. xxviii. and 364. *Maps, Illustrations, and Diagrams.* Price 10s. 6d. net. Presented by the Publisher. [See review, ante, p. 96.]

Colombia—Ethnology.**Pittier de Fábrega.**

Ethnographic and linguistic notes on the Paez Indians of Tierra Adentro, Cauca, Colombia. By Henry Pittier de Fábrega. (From the *Memoirs of the American Anthropological Association*, vol. 1, No. 5.) Lancaster, Pa., 1907. Size 10 × 6½, pp. 301-356. *Map and Illustrations. Presented by the Author.*

The Paez Indians inhabit a portion of the Central Cordillera in about 3° N.

Cuba.*B. American G.S.* 39 (1907): 257-268.**Fernow.**

The High Sierra Maestra. By B. E. Fernow. *With Map.*

Ecuador—Geodesy.*C.R.A. Sc. Paris* 145 (1907): 366-370.**Poincaré.**

Rapport présenté au nom de la Commission chargée du contrôle scientifique des opérations scientifiques de l'Équateur. Par H. Poincaré.

Peru.**Garland.**

Peru in 1906; with a brief historical and geographical sketch. By Alexander Garland, translated by George H. Gepp. Lima, 1907. Size 13½ × 10, pp. 304. *Maps and Illustrations. Presented by the Author.* [See p. 97, ante.]

Peru—Language.**Markham.**

Vocabularies of the general language of the Incas of Peru, or Runa Simi (called Quichua by the Spanish grammarians). By Sir Clements Markham. London, Ballantyne & Co., 1907. Size 6½ × 4½, pp. 252. *Presented by the Author.*

These vocabularies "consist of carefully selected words, and are intended to be useful to . . . English-speaking residents in Peru, to travellers, and also to students of history and philology." They embody Sir Clements Markham's previous contributions to the subject, during a period of over forty years.

South America.**Delebecque.**

A travers l'Amérique du Sud. Par J. Delebecque. Deuxième édition. Paris: Librairie Plon, 1907. Size 7½ × 4½, pp. viii. and 318. *Maps and Illustrations. Presented by the Author.*

A vivid narrative of a journey made in 1904-5, from Lima to Para, *viz* the Pachitea, Ucayali, and Amazon.

West Indies—Jamaica.**Price.**

The Agricultural Conference, 1907; and the Kingston disaster. Being a record of events in connection with the voyage of the S.S. *Port Kingston* from Barbados to Jamaica and back in January, 1907. Compiled by A. B. Price, 1907. Size 8 × 5, pp. 120. *Illustrations. Price 1s.*

West Indies—Jamaica. *Scottish G. Mag.* 23 (1907): 535-543.**Brown.**

The Jamaica earthquake. By Prof. Charles W. Brown.

West Indies—Jamaica.*R. Engineers J.* 6 (1907): 213-217.**Carden and Goldney.**

Notes on the Jamaica earthquake, January 14, 1907. By Captain A. D. Carden and Captain G. T. B. Goldney. *With Illustrations.*

West Indies—Santa Cruz.**Quin.**

The building of an island, being a sketch of the geological structure of the Danish West Indian island of St. Croix, or Santa Cruz. By John T. Quin. Published by the Author in Christiansted, St. Croix, 1907. Size 11½ × 8½, pp. viii. and 106. *Maps, Sections, and Illustrations. Presented by the Author.*

AUSTRALASIA AND PACIFIC ISLANDS.**Australasia.****Macdonald.**

In the land of pearl and gold: a pioneer's wanderings in the backblocks and pearly grounds of Australia and New Guinea. By Alexander Macdonald. London: Blackie & Son, 1907. Size 9 × 5½, pp. xii and 318. *Illustrations. Price 10s. 6d. net. Presented by the Publishers.*

Australasia.**Gregory.**

Stanford's Compendium of Geography and Travel (new issue). Australasia. Vol. 1, Australia and New Zealand. By Dr. J. W. Gregory. 2nd edition. London: E. Stanford, 1907. Size 8 × 5, pp. xxiv. and 658. *Maps and Illustrations. Price 15s. Presented by the Publisher.* [To be reviewed.]

Pacific Islands.**Grimshaw.**

In the strange South Seas. By Beatrice Grimshaw. London: Hutchinson & Co., 1907. Size 9 × 5½, pp. x. and 382. *Illustrations. Price 16s. net. Presented by the Publishers.*

POLAR REGIONS.

- Arctic.** *National G. Mag.* 18 (1907): 446-450. **Peary.**
Nearest the Pole. By Commander Robert E. Peary.
- Arctic—Exploration.** **Gordon.**
Round about the North Pole. By W. J. Gordon. London: John Murray, 1907. Size 6 x 6, pp. xii. and 294. *Maps and Illustrations.* Price 15s. net. *Presented by the Publisher.*
Most of the illustrations are woodcuts by Edward Whympers.
- Arctic—Ziegler Expedition.** **Fleming.**
The Ziegler Polar Expedition, 1903-1905: Anthony Fiala, Commander. Scientific results, obtained under the direction of William J. Peters. Edited by John A. Fleming. Washington, D.C., 1907. Size 11½ x 9½, pp. x. and 630. *Maps, Illustrations, and Diagrams.* *Presented by the Estate of William Ziegler.*
- Greenland—Area.** *Meddelelser om Grønland* 33 (1907): 121-128. **Prytz.**
Om Grønlands Areal Beregninger, udførte paa det af Kommissionen i 1806 udgivne Kaart i Maalestokken 1:2,000,000. Af H. Prytz. *With Map.*
See note in vol. 30, p. 567.

MATHEMATICAL GEOGRAPHY.

- Mathematical Geography.** **Johnson.**
Mathematical geography. By Willis E. Johnson. New York, etc.: American Book Co., [1907]. Size 7½ x 5, pp. 386. *Maps and Illustrations.* Price \$1. *Presented by the Publishers.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

- Climatology.** *Beiträge zur Geophysik* 8 (1907): 565-602. **Spitaler.**
Die jährlichen und periodischen Änderungen der Wärmeverteilung auf der Erdoberfläche und die Eiszeiten. Von Prof. Dr. Rudolf Spitaler.
- Geophysics.** **See.**
On the temperature, secular cooling and contraction of the Earth, and on the theory of earthquakes held by the ancients. By T. J. J. See. (Reprinted from *Proceedings of the American Philosophical Society*, vol. 48, 1907.) [Philadelphia, Pa., 1907.] Size 9½ x 6½, pp. 191-299. *Diagrams.* *Presented by the Author.*
- Geophysics—Soil-temperatures.** *Beiträge zur Geophysik* 8 (1907): 499-564. **Kühl.**
Der jährliche Gang der Bodentemperatur in verschiedenen Klimaten. Von Wilhelm Kühl. *With Diagrams.*
- Gravity.** *Riv. G. Italiana* 14 (1907): 361-369. **Costanzi.**
Abbozzo d'una carte delle isonormali della gravità nell' Europa centrale e nel Giappone meridionale. Per Giulio Costanzi. *With Maps.*
- Meteorology.** **Hepworth.**
Notes on maritime meteorology. By M. W. Campbell Hepworth. London: G. Philip & Son, 1907. Size 8½ x 5½, pp. viii and 90. *Charts and Diagrams.* Price 2s. 6d. net. *Presented by the Publishers.*
- Meteorology—Instruments.** **Mill.**
Quarterly J.R. Meteorological S 33 (1907): 265-274.
The best form of rain-gauge, with notes on other forms. By Dr. H. R. Mill. *Illustrations and Diagrams.*
- Oceanography—Arctic Ocean.** **Knipovich.**
Mem. Imp. Russian G.S.; General G 42 (1906): pp. xii. and 1510.
Grundzüge der Hydrologie des europäischen Eismeres. Von N. M. Knipowitsch. [In Russian; German résumé.]
- Oceanography—Currents.** **Gehrke.**
Conseil Perm. Explor. Mer; Publ. circonstance, No. 40 (1907): pp. 18.
Mean velocity of the Atlantic currents running north of Scotland and through the English Channel. By Johann Gehrke. *With Sketch-map and Sections.*

Oceanography—Currents.**Knudsen.***Conseil Perm. Explor. Mer*; Publ. circonstance, No. 39 (1907): pp. 8.

Some remarks about the currents in the North Sea and adjacent waters. By Martin Knudsen.

Oceanography—North Atlantic.**Mecking.***Ann. Hydrographie* 35 (1907): 348-355, 396-409.Die Treibeiserscheinungen bei Neufundland in ihrer Abhängigkeit von Witterungsverhältnissen. Von Dr. L. Mecking. *With Charts and Diagrams.*

Noticed in the Monthly Record (vol. 30, p. 661).

Oceanography—Pacific. *Ann. Hydrographie* 35 (1907): 253-259.**Schott.**Strombeobachtungen I.N.M.S. *Edi* in westlichen Stillen Ocean Von Prof. Dr Gerhard Schott. *With Map.***Oceanography—Relief.****Ricchieri.**Per la classificazione e denominazione morfografica dei fondi sottomarini. Di G. Ricchieri. (VI Congresso Geografico Italiano, Venezia, 26-31 Maggio, 1907. Sezione I., Tema I.) Venezia, 1907. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 10.**Physical Geography.****Supan.**Grundzüge der physischen Erdkunde. Von. Prof. D. Alexander Supan. Vierte . . . Auflage. Leipzig: Veit & Co., 1908 [1907]. Size 9×6 , pp. x. and 936. *Maps, Illustrations, and Diagrams. Presented by the Author.* [To be reviewed.]**Physical Geography.****Salisbury.**Physiography. By Rollin D. Salisbury. London: John Murray, 1907. Size $4\frac{1}{2} \times 5\frac{1}{2}$, pp. xx and 770. *Maps, Illustrations, and Diagrams. Price 21s. net. Presented by the Publisher.* [To be reviewed.]**Phytogeography.***J. Manchester G.S.* 23 (1907): 28-42.**Russell.**The relation between the geographical position and the productive capacity of land. By Dr. Edward J. Russell. *With Illustrations and Diagrams.***River terraces.***Mkk.G. Ges. Wien* 50 (1907): 38-40.**Schaffer.**

Ueber den Zusammenhang der alten Flussterrassen mit den Schwankungen des Meeresspiegels. Von Dr. Franz Xavier Schaffer

Sedimentation.*J. Geology* 15 (1907): 238-250**Mead.**Redistribution of elements in the formation of sedimentary rocks. By Warren J. Mead. *With Diagrams.***Seismology.***B. Imp. Earthquake Investigation Com.* 1 (1907): 75-113.**Omori.**Notes on the Volcanic and Aleutian earthquakes of August 17, 1906. By Dr. F. Omori. *With Maps and Diagrams.***Seismology.***G.Z.* 13 (1907) 142-153.**Sapper.**

Die geographische Verbreitung der Erdbeben. Von K. Sapper.

Speleology.**Jeannel and Racovitza.**Biospéologie. II. Énumération des grottes visitées, 1904-1906 (1^{re} série) Par H. Jeannel et E. G. Racovitza. (*Archives de Zoologie expérimentale et générale*, IV^e Série, Tome vi., No. 8.) Paris, 1907. Size $9\frac{1}{2} \times 6$, pp. 489-536. *Presented by the Authors.***Speleology.****Racovitza.**Essai sur les problèmes biospéologiques. Par Émile G. Racovitza (*Archives de Zoologie expérimentale et générale*, IV^e Série, Tome vi., No. 7.) Paris, 1907. Size $9\frac{1}{2} \times 6$, pp. 371-488. *Presented by the Author.***Terrestrial Magnetism.****Bauer.**Recent results of terrestrial magnetic observations. By L. A. Bauer. (Reprinted from the *Technology Quarterly*, vol. 30, No. 2 June, 1907) Size $10\frac{1}{2} \times 7$, pp. 170-186. *Maps, Diagram, and Illustration.***Terrestrial Magnetism.****Bauer.**Report of the Department of Research in Terrestrial Magnetism. By L. A. Bauer. (Extracted from the Fifth Year-book of the Carnegie Institute of Washington.) Washington, 1907. Size $10 \times 7\frac{1}{2}$, pp. 236-242. *Illustrations.*These two papers include accounts of the magnetic survey of the Galilee in the Pacific (*Journal*, vol. 27, p. 92; 28, p. 184; 30 p. 664).

- Volcanoes.** *Globus* 91 (1907): 277-280, 303-305. **Knebel.**
Theorien des Vulkanismus. Ein Rundblick auf ältere und neuere Lehren. Von
 Walther von Knebel.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

- Anthropology—Culture.** **Elliot.**
The romance of Savage Life. Describing the life of primitive man, his customs, occupations, language, beliefs, arts, crafts, adventures, games, sports, etc., etc. By G. F. Scott Elliott. London: Seeley & Co., 1908 [1907]. Size 8 x 5, pp. 384. *Illustrations. Presented by the Author.*
- Political Geography—Frontiers.** **Curzon.**
The Romanes lecture, 1907. Frontiers. By the Right Hon. Lord Curzon of Kedleston. Oxford: Clarendon Press, 1907. Size 9 x 6, pp. 58. *Price 2s. net. Presented by the Publishers.*

BIOGRAPHY.

- Amundsen.** *Terrestrial Magnetism* 12 (1907): 36. — —
Sketch of life and work of Røld Amundsen.
- Buchan.** *Scottish G. Mag.* 23 (1907): 427-431. **Mill.**
Dr. Alexander Buchan. By Dr. Hugh Robert Mill.
- McLoughlin.** **Holman.**
Dr. John McLoughlin, the father of Oregon. By Frederick V. Holman. Cleveland: The A. H. Clark Co., 1907. Size 9½ x 6, pp. 302. *Portraits. Price \$2.50.*
The subject of this memoir played an important part in the early opening up of Oregon.

GENERAL.

- British Empire.** **Paton.**
Handbooks on British Colonies, 1907. Compiled by Walter Paton. London: Emigrants' Information Office, 1907. Size 8½ x 5, pp. [764]. *Maps. Price 2s. Presented by the Emigrants' Information Office.*
- British Empire.** **Knight.**
Over-sea Britain. A descriptive record of the geography, the historical, ethnological, and political development, and the economic resources of the Empire. By E. F. Knight. (Vol. 1) *The nearer Empire: The Mediterranean, British Africa, and British America.* London: J. Murray, 1907. Size 9 x 5½, pp. xii. and 324. *Maps. Price 6s. net. Presented by the Publisher. [See notice on p. 100, ante.]*
- British Museum.**
The history of the collections contained in the Natural History Departments of the British Museum. Vol. 2. London, 1906. Size 9 x 5½, pp. 782. *Presented by the British Museum (Natural History).*

- Educational.** **Halkin.**
L'enseignement de la géographie à l'Université de Liège. Par Joseph Halkin. (Travaux du Séminaire de Géographie de l'Université de Liège, Fascicule vi.) Liège, 1907. Size 9 x 6, pp. 40.

- Geological Society.** **Woodward.**
The history of the Geological Society of London. By Horace B. Woodward. London: Geological Society, 1907. Size 9 x 5½, pp. xx. and 336. *Portraits and Illustrations. Presented by the Author. [To be reviewed.]*

- Index.**
The annual Index to the Times, 1906. London: Times Office, [1907]. Size 10 x 6, pp. 892.

- Levant.** **Margoliouth.**
Cairo, Jerusalem, and Damascus: three chief cities of the Egyptian Sultans. By D. S. Margoliouth. London: Chatto & Windus, 1907. Size 9½ x 6½, pp. xvi. and 302. *Illustrations. Price 20s. net. Presented by the Publishers.*

- Metrie System.**
A Bill to render compulsory the use of the system of weights and measures commonly known as the Metrie System. London, 1907. Size 13½ x 8½, pp. 6.

- Metrie System.**
British r. Metrie weights and measures. Reports of the Conference of

Representatives of the Cotton and allied Trades, and of the Parliamentary Debate on the Weights and Measures (Metric System) Bill. London and Manchester, [1907]. Size 7 x 5, pp. iv. and 62. *Map*

Nature-study.

Carey.

The mammoth hunters. By Alfred E. Carey. London: Greening & Co., 1907. Size 8 x 5, pp. xii. and 308. *Illustrations. Price 6s. Presented by the Author.*

Place-Names.

Third report of the United States Board on geographic names, 1890-1906. Washington, 1907. Size 9 x 6, pp. 182.

Embodies all the decisions of the Board from 1890 to 1906. Among forms adopted are: Riu-kiu; Rainier (not Tacoma); Everest (not Gaurisankar); Foochow (not Fuchau, yet we find "Fukien" on the next page). Meares' name "Cape Disappoint-ment" is retained for the cape at the Columbia river, but the tale of his voyage and the ship in which it was made are wrongly given

Plant-distribution.

Guppy.

Plant-distribution from an old standpoint. By H. B. Guppy. Size 8½ x 5½, pp. 34. *Presented by the Author*

NEW MAPS.

By E. A. REEVES, *Map Curator, R.G.S.*

EUROPE.

Austria-Hungary.

Artaria.

Artaria's Eisenbahnkarte von Österreich-Ungarn mit Stationsverzeichnis, 1908. Vierte Neubearbeitung, viii. Auflage. Scale 1: 500,000 or 1 inch to 7·8 stat. miles. Vienna: Artaria & Co., [1907]. *Price 2·20 kr. Presented by the Publisher.*

British Isles.

Royal Commission for Canals and Waterways.

Map of the canal systems and navigable rivers of England and Wales. Scale 1: 633,600 or 1 inch to 10 stat. miles. 2 sheets.—Map of the canals and navigable rivers in the catchment basins of England and Wales. Scale 1: 633,600 or 1 inch to 10 stat. miles. 2 sheets.—Map of the canal systems and navigable rivers of Scotland. Scale 1: 633,600 or 1 inch to 10 stat. miles.—Map of the canals and navigable rivers of Ireland. Scale 1: 633,600 or 1 inch to 10 stat. miles. Southampton: Ordnance Survey Office, 1905-07. *Presented by the Royal Commission on Canals and Waterways.*

The 16-miles-to-an-inch Ordnance Survey maps of the British Isles forms the basis of these canal maps. They are printed lightly in brown and blue, and upon them the special information connected with catchment basins, canals and navigable rivers is given in different colours and symbols. Against the names of the principal cities and towns, as well as the counties, the population is stated in clear figures. The maps have been specially prepared at the Ordnance Survey Office to accompany the report of the Royal Commission on Canals and Waterways. On the map of England showing catchment basins, the average rainfall is given in figures for various districts, the authority for the necessary information being Dr. H. R. Mill.

England and Wales.

Ordnance Survey.

Sheets published by the Director-General of the Ordnance Survey, Southampton, from December 1 to 31, 1907.

2 miles to 1 inch:—

Large-sheet series, printed in colours, folded in cover or flat in sheets, 11, 16. *Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.*

1 inch (third edition):—

In outline, 101, 111, 140, 158, 336, 352. *1s. each (engraved).*

With hills in brown or black, 101, 111, 123, 140, 156, 158, 336, 352. *1s. each (engraved).*

Towns and country around, with roads printed in colour, folded in cover or flat in sheets. Bristol. *Price, on paper, 1s.; mounted on linen, 1s. 6d.*

Large-sheet series, printed in colours, folded in cover or flat in sheets, 1, 2, 3, 4, 5, 6, 7, 8, 9, 24, 122. *Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.*

6-inch—County Maps:—

Cornwall (First Revision), 39 N.E., S.W., 45 S.W., 47 S.W., 48 N.W., N.E. **Cornwall** (First Revision) (13 N.E. and 14 N.W.), 14 S.W., S.E., 19 N.E., 20 N.W., S.E., 32 S.W., S.E., 39 N.W., 40 N.E., 50 S.E., 52 N.W. **Devonshire** (First Revision), 111 S.W., 129 N.E. **Kent** (Second Revision), 48 N.W., S.W. (58 N.E. 58a N.W.). **Lincolnshire** (First Revision), 18 N.W., S.W., S.E., 70 N.W., S.W. **Pembrokeshire** (First Revision), 6 S.W., 11 N.E., 18 N.E., 29 N.W., N.E., 36 S.W. **Yorkshire** (First Revision of 1891 Survey), 238 S.W., 248 N.E., S.E., 249 S.W., S.E., 259 N.E., 260 S.E., 261 N.E., 262 N.W., 266 N.W., 278 S.E. 1s. each.

25-inch—County Maps:—

Cornwall (First Revision), LXI. 9, 10, 13, 14, 15; LXIa. 16; LXII. 2, 3, 7, 10, 11; LXIV. 14; LXVIII. 2; LXX. 6, 7, 8, 10, 11, 12, 14, 15, 16; LXXI. 4, 12; LXXVI. 4, 7, 8, 11, 12, 14, 15; LXXVII. 1, 5, 9, (11 and 16), 13, 14 (16 and 11); LXXX. 2, 3, 4; LXXXI. 1. **Kent** (Second Revision), XXXIV. 5, 9, 13; XLIV. 4; XLV. 1; LXIV. 6, 9, 10, 12, 13, 16; LXV. 9. LXXI. 2, 3, 4, 6, 7, 10, 11. LXXII. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16. LXXX. 2, 3, 4, 6, 7, 8, 10, 11, 12; LXXXI. 5. **Lincolnshire** (First Revision of 1891 Survey), CII. 7. CVII. 9, 10, 11, 13, 14, 15. **Lincolnshire** (First Revision), V. 4, 8, 11; VI. 1, 7; XIII. 7, 8, 11; XIV. 9, 13, 14. *See each.* V. 6. 1a. 6d. **Norfolk** (First Revision), LXIII. 3, 7, 8, 10, 11, 12, 14, 15, 16; LXIV. 1, 5. **Pembrokeshire** (First Revision), IV. 5, 13, 14; V. 5, 6, 9, 10, 14; IX. 1, 2, 4, 11; X. 1, 2, 5, 6; XXI. 2, 5, 6, 11, 12, 15, 16; XXVI. (4 and 3), 8, 12; XXVII. 8. **Yorkshire** (First Revision of 1891 Survey), CCXX. 8; CCXXI. 1, 2, 4, 5, 8, 9, 12, 13, 14, 15, 16; CCXXXII. 5, 9, 10, 11, 12, 13, 14, 15, 16; CCXXXIII. 7, 9, 10, 13, 14; CCXXXV. 10, 12, 13. *See each.*

(*E. Stanford, London Agent.*)

Europe—Central.**K. Preussische Landesaufnahme**

Topographischen Spezialkarte von Mittel-Europa. Herausgegeben von der kartographischen Abtheilung der Königl. Preussischen Landesaufnahme. Scale 1: 200,000 or 1 inch to 3.1 stat. miles. Sheets: 299, Dordrecht; 301, Wesel; 328, Ghent; 330, München-Gladbach. Berlin K. Preussische Landesaufnahme, 1907. *Price* 1 00m. each sheet.

Europe—Central.**Ravenstein and Liebenow**

Ravenstein-Liebenow's Special. Rad- und Automobilekarte von Mittel-Europa. Scale 1: 300,000 or 1 inch to 4.7 stat. miles. Sheets 108, Sanok; 122, Kaschau. 136, Miakolez; 150, Debreczen; 160, Graz; 161, Steinamanger; 163, Kecskemet; 164, Csaba. Frankfurt-am-Main Ludwig Ravenstein, [1907].

France.**Ministre de l'Intérieur, Paris**

Carte de la France dressée par ordre du Ministre de l'Intérieur. Scale 1: 100,000 or 1 inch to 1.6 stat. mile. Sheets: m. 17, Pont-l'Abbe; xii 11, Le Havre (sud); xiii-13, Laigle; xiii. 14, Martagne; xiii. 37, Bagnères-de-Luchon; xv-12, Les Andelys; xviii 20, La Charité; xx 29, Le Montier; xxiv. 23, St. Claude; xxvi-24, Vallorcine. Paris. Ministère de l'Intérieur, Service Vicinal, 1907. *Price* 0.80 fr. each sheet.

Greece.**Marées.**

Karte des Sundes zwischen Leukas und Akarnanien. Reduktion nach der Aufnahme von Hauptmann v. Marées im März u April 1905. Scale 1: 50,000 or 1.3 inch to 1 stat. mile. *Petermanns Mitteilungen*, Jahrgang 1907, Tafel 20. Gotha: Justus Perthes, 1907. *Presented by the Publisher*

ASIA.**Java.****Topographische Inrichting, The Hague**

Topographische Kaart der Residentie Soerakarta. Scale 1: 100,000 or 1 inch to 1.6 stat. mile. 6 sheets. The Hague: Topographische Inrichting, 1906.

The 1894 edition of this map with the tramways revised to 1906.

AFRICA.**Africa.****Topographical Section, General Staff.**

Map of Africa. Compiled in the Topographical Section, General Staff. Scale 1: 250,000 or 1 inch to 3.9 stat. miles. Sheets: Somaliland, 68-G, Biyo Kaboba; 68-H, Harag Jid; 68-I, Bulbar; 68-M, Harrar; 68-N, Jifar Medir; 68-O, Adaleh. London: Topographical Section, General Staff, War Office, 1907. *Price* 1s. 6d. each sheet. *Presented by the Director of Military Operations.*

Angola.**Griffiths & Co**

Benguela Railway. Plan showing railway from Lobito bay to 750 kilometres.

Scale 1 : 400,000 or 1 inch to 6·3 stat. miles. London: Griffiths & Co., [1907]. *Presented by the Publisher.*

A black-and-white lithograph of a traverse along the line of the proposed railway from Lobito bay, near Benguela, into the interior for a distance of 750 kilometres (466 miles). The line to be followed by the railway is shown as well as the country for about 10 miles on either side.

Egypt.

Survey Department, Cairo.

Topographical map of Fayum Province. Scale 1 : 10,000 or 6·3 inches to 1 stat. mile. Sheets: s.w. 12-1, 12-6, 12 and 13-3, 13-2, 13-4, 14-2, 14-3, 14-4, 14-5, 14-6, 15-2, 15-3, 15-4, 15-5, 15-7. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Morocco.

Larras.

Carte de reconnaissance du Maroc, levées et dessinées par le Capitaine N. Larras, 1898-1906. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheets: Casablanca, Safi-Marrakech. Paris: Henry Barrère, [1907]

These are the first two sheets of a new large-scale map of parts of western and central Morocco, compiled chiefly from surveys and sketches by Captain N. Larras. There will be altogether seven sheets, which are to include all the more important districts of the country. The map is printed in colours, relief being shown by horizontal form lines in brown, at approximating intervals of 50 metres. On the present sheets are inset plans of Casablanca and Safi, on the scale of 1 : 10,000.

South Africa.

'South Africa.'

The railway map of South Africa. Scale 1 : 1,000,000 or 1 inch to 63·1 stat. miles. London: Offices of *South Africa*, 1907

This railway map, which has been revised to date, is published as a supplement to the number of *South Africa* for November 23, 1907.

AMERICA.

Chile.

Boloña and Bertrand.

Nuevo mapa de Chile. Formado con arreglo a los datos oficiales mas recientes i los últimos levantamientos efectuados por las Comisiones de Limites. Por Nicanor Boloña. Revisado i aprobado por el ingeniero Sr. Alejandro Bertrand, Jefe de la Oficina Demarcadora de Limites. Scale 1 : 2,000,000 or 31·6 stat. miles to an inch. Santiago: Carlos Tornero, 1904.

Chile.

Dirección de Obras Públicas, Santiago.

Carta jeográfica y minera de los 31° 30' a 33° 10' de Lat. Sur. que comprende la provincia de Aconcagua y parte de las de Coquimbo, Valparaíso y Santiago. Levantada y construida por la Sección de Jeografía y Minas de la Dirección de Obras Públicas. Publicado bajo la dirección del Sr. José del C. Fuenzalida. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. 6 sheets. Santiago: Dirección de Obras Públicas, 1905.

This map marks a decided advance in the cartography of Chile. It includes the whole of the country from the coast-line to the eastern boundary lying between the parallels of 31° 30' and 33° 10' S. lat., and thus embraces Valparaíso and the line of the trans-Andine railway, as well as the peak of Aconcagua. Relief is shown by contour-lines in brown at 100-metre intervals, the 500-metre contours being distinguished by a dotted line, and the 1000-metre by a thick line, which arrangement greatly assists the eye in following the lines. These contours can only be considered as approximately correct in many places, but they serve well to give a good general idea of the relative heights of land. In addition to the contours, absolute heights are shown in black figures. Water is shown in blue, and boundaries red. Useful information concerning location of minerals is given on the map by various symbols, and taken altogether the map is a most creditable production. In the Andine region the surveys of the recent Boundary Commission have formed a good basis for the topographical features. The height of the peak of Aconcagua is given as 7004 metres (22,979 feet), but it may be pointed out that by the latest trigonometrical determination of Fr. Schrader it is 22,812 feet.

Chile.

Oficina de Limites, Santiago.

Comision Chilena de Limites. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheets: Atacama. Santiago: Oficina de Limites, 1907. *Presented by the Oficina de Limites, Santiago.*

These two sheets deal with the northern section of the Chilo-Argentine boundary, and include the region bordering on the Atacama desert between 27° and 29° S. lat.

and 68° and 70° 50' W. long. In addition to the topographical sheets, there are, as before, skeleton sheets showing the lines of traverses and triangulation.

United States.

U.S. Geological Survey.

Geologic atlas of the United States. Scale 1: 125,000 or 1 inch to 1.9 stat. mile. Folios: 141, Bald mountain—Drayton, Wyoming; Cloud peak—Fort McKinney, Wyoming; Nantahala, North Carolina—Tennessee; Amity, Pennsylvania; Lancaster—Mineral Point, Wisconsin—Iowa—Illinois; Rogersville, Pennsylvania; Pisgah, North Carolina—South Carolina; Joplin district, Missouri—Kansas; Penobscot bay, Maine; Devil's Tower, Wyoming. Washington: Department of the Interior, U.S. Geological Survey, 1906-07. Price 25 cents. each folio. *Presented by the United States Geological Survey.*

AUSTRALASIA.

Queensland.

Ball.

Copper-mining district of Cloncurry, North-Western Queensland. Based on Queensland 4-mile map issued by Department of Public Lands, and showing freeholds and mineral leases. Compiled from official and other sources, under the supervision of L. C. Ball, B.E., Assistant Government Geologist. Scale 1: 380,160 or 1 inch to 6 miles. Brisbane. Queensland Geological Survey, 1907.

POLAR REGIONS.

South Georgia.

Szielasko.

Karte der Cumberland Bay (Sud-Georgien). Von A. Szielasko. Scale 1: 125,000 or 1 inch to 1.9 stat. mile. *Petermanns Mitteilungen*, Jahrgang, 1907, Tafel 21. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

GENERAL.

World.

Freitag.

G. Freitag's Welt-Atlas. Dritte, vermehrte Auflage. Vienna and Leipzig: G. Freitag & Berndt, 1908. *Presented by the Publisher.*

A new edition of a small pocket atlas, with additions and corrections. The maps vary considerably in merit, and in some, as No. 59, the imperfect registering of the colours seriously interferes with their clearness.

World.

Harmsworth.

Harmsworth Atlas and Gazetteer. Parts 30 & 32. London: The Amalgamated Press, Limited, 1907-8. Price 7d. each part.

These parts contain the following maps:—Part 30. Nos. 85-86, Balkan States and Asia Minor (industries and communications); 131-132, Asiatic Russia; 143-144, Central Africa. Part 31. Nos. 87-88, Turkey in Europe; 181-182, Mexico and Central America; 193-194, South America (south). Part 32: Nos. 89-90, Greece, Crete, and the Archipelago; 111-112, Egypt and the Sudan; 163-164, Central Canada.

World.

St. Martin and Schrader.

Atlas Universel de Géographie construit d'après les sources originales et les documents les plus récents, cartes, voyages, mémoires, travaux géodésiques, etc., avec un texte analytique. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. Sheet No. 68, Afrique Australe. Paris: Hachette et Cie., 1907. *Presented by the Publisher.*

A glance at the letterpress which accompanies this sheet will show that the best and most reliable documents have been utilized in the compilation. Like all the other sheets of this atlas, the drawing and engraving are excellent, but it would certainly be an improvement in general effect, and render the names more clearly legible, if the hill work could be printed in brown instead of black.

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published by the Hydrographic Department, Admiralty, during November, 1907. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
8676 m	= 0.9	United States, east coast:—Fletcher's neck to Merrimac river. 8s.
8678 m	= 7.9	British Columbia:—Port Simpson. 8s.

No.	Inches.	
3660 m	= 11·8	Gulf of Aden:—Aden harbour. 3s.
7 m	= 2·9	Gulf of Aden:—Aden harbour and approaches. 4s.
3666 m	= $\begin{cases} 0·8 \\ 3·9 \\ 5·9 \end{cases}$	East coast of Korea:—Fusan harbour to Chukupen bay. Chukupen bay. Chukusan po. 3s.

Charts Cancelled.

No.	Cancelled by.	No
7 Gulf of Aden:—Aden and adjacent bays, Aden anchorage.	New chart.	
54 Ports and anchorages on the east coast of Korea:—Plan of Cheku-pien bay on this sheet.	Aden harbour and approaches Plan of Chukupen bay on new chart	7 3666

Charts that have received Important Corrections.

No. 240, England, south coast:—Hamoaze 2682, England, west coast:—Nash point to New passage. 1538, Ireland, west coast:—Foynes harbour. 2049, Ireland, south coast:—Kinsale to Wexford. 2241, Baltic:—Entrance to gulf of Finland and northern entrance to the gulf of Riga 2285, Black sea:—Varna, Baljik bay. 238, Africa, north coast:—Suez canal. 330, North American lakes:—Lake and river St. Clair with the Detroit river. 612, North America, east coast:—Little Spoon island to Pemaquid point. 2853, Gulf of Mexico:—Mississippi sound and Mobile bay. 229, United States, west coast:—Point Pinos to Bodega head. 2172, Alaska:—Bering strait. 628, Africa, west coast:—Fernando Po island. 2404, Singapore main street from Tree island to Batam bay. 2023, Singapore:—Keppel harbour. 1199, China, east coast:—Kue shan islands to the Yang tso Kiang. 1601, China, north-east coast:—Wusung river. 3412, Tasmania:—Hunter passage. 781, Pacific ocean:—North-west sheet. 783, Pacific ocean:—South-east Sheet. 2460, Pacific ocean:—Kamchatka to Kadiak island, etc.

(J. D. Potter, Agent.)

Indian Ocean and Red Sea.

Meteorological Office.

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, January, 1908. London: Meteorological Office, 1907. Price 6d. each. Presented by the Meteorological Office.

North Atlantic and Mediterranean.

Meteorological Office.

Monthly meteorological charts of the North Atlantic and Mediterranean, January, 1908. London: Meteorological Office, 1907. Price 6d. each. Presented by the Meteorological Office.

North Atlantic.

U.S. Hydrographic Office.

Pilot chart of the North Atlantic Ocean, December, 1907. Washington: U.S. Hydrographic Office, 1907. Presented by the U.S. Hydrographic Office.

North Pacific.

U.S. Hydrographic Office.

Pilot chart of the North Pacific Ocean, January, 1908. Washington: U.S. Hydrographic Office, 1907. Presented by the U.S. Hydrographic Office.

PHOTOGRAPHS.

Canada.

Firth, Holmden, and Jones.

Thirty-six photographs of North-Western Canada, taken by Messrs. J. F. Firth, S. M. Holmden, and H. W. Jones. Presented by A. H. Harrison, Esq.

Collected by Mr. Harrison during his recent journey in North-Western Canada, and on his return, presented by him to the Society.

(1) Mr. H. Firth and his wife; (2) A creek just before the freeze-up, Fort McPherson; (3) Gorge in the Davidson range; (4) Indians on the Peels river; (5) Natives arriving at Fort McPherson for spring trade; (6) *Midnight Sun* seen from Fort McPherson; (7) Hay river post, new buildings by Mr. Marsh; (8) Fort McPherson, looking across Peels river; (9 and 10) A lake near Peels river; (11) The Firth family, Fort McPherson; (12) H.B. Co.'s transport starting for Herschell island from Fort McPherson; (13) J. F. Firth and his dogs; (14) H. Firth and his dogs; (15) Wild roses, Fort Simpson; (16) At Fort Simpson, June 12, 1905; (17) Wrigley harbour;

(18) A whale-boat being towed up Peels river; (19) Fort Simpson; (20) The back of Fort Simpson; (21) H.B. Co.'s steamer at Wrigley harbour; (22) Protestant Mission at Fort Norman; (23) Pelican rapid, Fort Smith; (24) The Ramparts above Good Hope; (25) An old Indian woman making a tent; (26) The *Wrigley* taking wood aboard; (27) Roman Catholic mission at Fort Simpson; (28) Indian family at Fort Simpson; (29) Indian camp, Mackenzie river; (30) The "Huskies'" boats at anchor in the Peels river; (31) Natives and "Huskies" of Fort McPherson; (32) "Huskies" on the bank of Peels river; (33) The inhabitants of Fort McPherson coming out of church; (34) The *Midnight Sun* at Fort McPherson; (35) Fort McPherson; (36) The Indian post of Fort McPherson.

Canada.

Hammerstein.

Fifty-seven photographs of the Athabasca river, Canada, taken by Count Von Hammerstein. Presented by A. H. Harrison, Esq.

These photographs were brought home by Mr. A. H. Harrison on his return from his recent surveying expedition in the neighbourhood of the delta of the Mackenzie. They are representative of the mode of life and scenery in this part of North-West Canada.

(1-24) Views on the Athabasca river; (25) Cascade on Athabasca river; (26) Making portage, Athabasca river; (27) A Peterborough canoe on the Athabasca river; (28) Boat's crew, Athabasca river; (29 and 30) Skow on Athabasca river; (31) Tracking up-stream; (32 and 33) Fort Chipewyan; (34) Fort McMurray; (35) Camp at Fort McMurray; (36) Police-waggon on the trail; (37) The *Midnight Sun* on the Athabasca river; (38) Cree Indian coming in with meat; (39) Lake Athabasca, trading-post; (40) Rapids, Slave river; (41-43) Salt plains, (44-54) Boring for oil, Athabasca river; (55) Machinery on the bank of the Athabasca river; (56) Athabasca landing, putting machinery on board Skow; (57) Taking machinery ashore, Athabasca river.

Canada.

Harrison

Eighty-two photographs of North-West Canada, taken by A. H. Harrison, Esq. 1905-7. Presented by A. H. Harrison, Esq.

Mr. Harrison's journey and explorations, during which these photographs were taken, were described by him at a recent meeting of this Society. His lengthy stay at the delta of the Mackenzie gave him exceptional opportunities for photography in addition to his survey work, and these he fully availed himself of, as will be seen from the following list. The circumstances under which the views were taken were at times anything but favourable, and the results are quite as good as might be expected; in fact, some of the views are remarkably clear, and as lantern-slides were most effective, as those who attended his lecture will remember.

(1-4) Whaling captains; (5-7) Whaling crews; (8) Feeding dogs on board ship; (9) Summer scene, Herschel island; (10-15) Ships frozen in, Herschel island; (16 and 17) Eskimo camp; (18-20) Eskimo camp in the mountains; (21) Eskimo with load of deer meat; (22) Two Eskimo hunters; (23) Eskimo graveyard, Herschel island; (24) Ice off Cape Bathurst; (25-48) Drifting ice between Cape Kellett and Herschel island, August, 1906; (44) Arrival of steamer, Fort McPherson; (45) Travelling on the Arctic ocean; (46) Jacks in his kayak; (47) Kokatu fishing; (48) First camp in the spring; (49) Whale-boats going up Mackenzie river; (50) Our last camp on Mackenzie; (51 and 52) Indians travelling; (53) The back of my winter camp; (53) Natives of Arctic ocean; (54-59) No titles given; (60) Indian coming in with fish; (61) Nuns visiting the Indians; (62) Slave Indians in camp; (63) Mission steamer, Mackenzie river; (64 and 65) A robin's nest, Fort Simpson; (66) Flood; (67-69) Roman Catholic school, Fort Providence; (70) Building the boat *Midnight Sun*; (71) The Hay river post; (72) Group of Eskimo, Herschel island; (73) Athabasca landing; (74) Mission at Fort Providence; (75) The *Midnight Sun*, Fort McPherson; (76) Woolferine rock, Mackenzie river; (77) Red river post, Athabasca river; (78) Roman Catholic mission, Lesser Slave lake; (79) Church, Fort Resolution; (80) Eskimo in camp; (81) Group of Eskimo, Herschel island; (82) Edmonton.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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THE JAMAICA EARTHQUAKE (1907).*

By VAUGHAN CORNISH, DSc, FR.G.S., F.G.S., F.C.S., M.J.S.

IN a paper read before the Society in 1899, I introduced the term "Kumatology" to define the co-ordinate study of the waves of the lithosphere, hydrosphere, and atmosphere; and from 1897 to 1907 I have travelled in search of these phenomena, and presented papers upon some of them to the Society. My first experience of seismic waves on an important scale came to me without seeking when I happened to be at Kingston, Jamaica, on January 14, 1907.

On Thursday, January 10, my wife and I arrived at Kingston on our way back from a visit to the Panama canal, and took up our quarters in the centre of Kingston, at 112, East Street. This hotel, "The Grenville," which was built in the days of slavery, was very substantially constructed of brick, with solid walls 14 inches in thickness for their whole height of two floors, viz. a ground floor and a first floor. The roof, a sloping one, was of wooden shingles, and in the whole structure there was no chimney-stack, fires not being used for warmth in Kingston, and the kitchen being always separate from the dwelling-house. In front, that is to say on the west, of the house a row of massive brick arches formed a verandah to the ground floor, and supported a covered wooden balcony on the first floor. Our own room was a corner one on the first, that is to say the top, floor, having an

* Read at the Royal Geographical Society, December 9, 1907. Illustrated by photographs and diagrams by the author, and discussed at the Research Department, January 17, 1908. Map, p. 360.

outside wall to the south, and another 14-inch brick wall on the west, with two long French windows opening into the balcony.

In this room my wife and I were sitting at half-past three in the afternoon of Monday, January 14, when I heard the noise of an electric car coming from down town, that is to say, from the south. The noise increased, of course, till it was opposite the house, and then just as the rushing should have begun to diminish, there was a sudden and alarming increase of rushing and rumbling sound, accompanied by a savage tearing and rending noise. For a moment I felt no shock and did not realize the cause of the uproar, but my wife, who was sitting nearer the wall, felt a tremor, and, realizing that it was an earthquake, took one quick step to my side and clasped her arms over my head to shield me from the danger of falling masonry, to which she herself thus remained exposed. The next instant the whole house was rocking violently; a fissure opened horizontally near the top of the west wall facing me, and a shower of brickwork fell near the threshold of the door. Had my wife hastened to the door on feeling the shock, she would probably have been struck down at the moment of emergence, as happened in so many cases that day. A cloud of dust and mortar darkened the air, and the solid 14-inch brick wall vibrated to and fro, discharging a cannonade of brickwork into the room. A lump of masonry struck me a numbing blow on the shin. A heavy mahogany wardrobe behind me, but facing my wife the way she stood, executed a clumsy dance, and then pitched over; and the heavy cornice sailed over our heads and struck my wife on the hip in its descent. We were being bombarded both front and rear, but, even had there been any direction in which safety could be found, we were unable to fly, for the timber floor was like quicksand beneath the feet, rising and falling, and opening and shutting, so that we could see into the unceiled room below.

Up to this point one knew that these occurrences might at any instant terminate fatally, but the really awful time came when the house seemed suddenly to lose its cohesion, and we both realized that in another second the floor would give way and the walls fall bodily upon us. Then instant death seemed certain to both of us; but, strange as it may seem, the bitterness of death passed from us both almost instantly after the hope of life had been extinguished. I remember to have felt that such an end, instantaneously and together, was not unmerciful. At this supreme moment, with absolute suddenness, the quaking floor stiffened under our feet, our environment was instantaneously rigid and still, and the noise of the earthquake died away. We rushed from the dark and dust-laden room into the verandah, and down the steps into the sunny garden, where the earth was now quite firm beneath our feet.

We spent the next few days on the lawn by the house, and on the

Thursday we left Kingston for Port Antonio, on the north of the island, the train being crowded with sick and wounded. A week later we sailed for England *via* Philadelphia and New York.

During our short and eventful stay in Jamaica we had been much impressed by the generous spirit displayed by the colonists in the face of great financial losses. They scrupulously refrained from exploiting the public misfortune for private profit. We were also much struck with the kindness which they displayed to one another under very trying circumstances, as well as with the consideration which they showed towards the strangers within their gates.

On May 4, my wife having sufficiently recovered from her injuries, we set out again for Kingston, as I wished to investigate to the best of my ability the cause and effects of the earthquake, by which, and the subsequent fire, twelve hundred persons were killed, and a loss of about £2,000,000 incurred.

On our second visit we went out on board the S.S. *Port Kingston*, which bore the new Governor, and arrived on May 16, about the same time as news reached the island that the Home Government had made a grant of £150,000 to relieve destitution, and guaranteed a loan of £800,000 to facilitate the rebuilding of the city. We found the streets cleared of *débris*, the traction wires set up, and the electric cars running; otherwise everything looked exactly as it had been just after the earthquake, four months previously.

The economic importance of the Jamaica earthquake of January 14, 1907, is due to the destruction of Kingston and its suburbs, and here also the effects of seismic shock upon buildings can best be studied. Viewed, however, from the physical standpoint, the importance of an earthquake is independent of the neighbourhood of cities.

I think that I shall be able to show that the Jamaica earthquake was essentially double-barrelled, so to speak; that Kingston was brought down by one barrel, and that the other barrel was discharged in a thinly populated district, where it consequently did much less damage; but that when we examine the seismic effects in parts of the island distant from either of these foci, we find that they are, on the whole, about as much due to the one part of the double shock as to the other, the charge in the two barrels, so to speak, being about equal. From the physical standpoint, therefore, the Kingston earthquake is not quite the same thing as the Jamaica earthquake.

Thirty seconds is the duration currently assigned to the earthquake at Kingston, but no one really timed it there. At Kellits, about 35 miles north-west of Kingston, Mr. Horn informs me that the earthquake, timed with a watch, lasted 37 seconds, this space of time being divided as follows, *viz.* 17 seconds shaking, 13 seconds rolling, and again 7 seconds shaking, which finished with a distinct jerk. At Bethany, about 45 miles north-west of Kingston, Dr. Hargreaves informs me that he timed



FIG 1—HOUSE IN SOUTH CAMP ROAD, KINGSTON.



FIG 2—FIRST-FLOOR DRAWING-ROOM OF HOUSE IN EAST STREET, KINGSTON.



FIG. 3.—THE GARDENS HOUSE, GORDON TOWN.



FIG. 4.—HOUSE AT BUFF BAY.

the earthquake by a seconds-hand watch, and found that it lasted 30 seconds.

I have described the character of the vibrations which I experienced in a top story corner room of a brick house in East Street. These were only in a secondary sense due to the earthquake, the immediate cause being the action of the vibration of the massive walls upon the wooden floor. The movement of the ground was well observed opposite the old Mico, in Hanover Street, by Sub-Inspector Tremlett, and near the south end of John's Lane by Mr. Sullivan. In addition to any jarring or bumping, there was a strong swell, literally a ground swell, running from west to east or east to west. It nearly threw Mr. Tremlett down when he faced westward, but when he turned and faced south he easily kept his balance. Mr. Sullivan, who was running westward out of a falling building, with difficulty kept his feet, although accustomed to heavy weather at sea. He says the west-to-east roll was much stronger than the return roll from east to west. The impression generally received was that these surface undulations were only a few yards from crest to crest, and they certainly succeeded one another several times in a second. The height from crest to crest appeared to be several inches, so that their steepness was very considerable. As far as I am aware, the only instrumental evidence as to the periodic time of the earthquake oscillations is that afforded by the transmitter of the West India Direct Cable in Kingston. I learnt that it had continued to run for a time before the office collapsed, and that the strip of paper had been sent to the London office as a curiosity. I therefore timed the running of the machine in Kingston, and afterwards, in London, was allowed to measure the oscillations of the writing pen as recorded on the strip of paper. There were ten complete north-south-north oscillations in the first two and a half seconds, *i.e.* four per second. The position of the instrument did not permit it to record east-and-west vibrations.

I carefully examined a large number of buildings in Kingston, which is a brick town, to ascertain the line, or direction, and the sense in which walls had fallen. The town is laid out rectangularly, houses facing the four cardinal points, and in the detached houses east- and west-facing outer walls generally fell, while the fall of north- and south-facing walls was an exception, except in the area of greatest damage. Of the east- and west-facing walls many more fell to the east than to the west. In the neighbourhood of North Street, east of East Street, which I examined in detail, I found that of the north- and south-facing walls more fell to the south than to the north. Thus the walls tended to fall, in most cases, towards a little south of east, but in some cases a little north of west. I adopted 15° as a rough estimate of the amount of southing.

I consider that the fall of these walls was due to the action of the

surface waves above described in tilting the walls out of the perpendicular, first in one direction and then in the other, causing them to sway. If the waves were short, as they appeared to be, and as I think they were, the lower part of the wall was thrown very much out of plumb at each half-swing, and a wave of displacement travelled up each wall, so that it became sinuous in form and was subjected to rippling movement.

The mere rapid jarring vibration, which was so marked a feature of the sensations of the earthquake, probably had little effect in overthrowing walls. The north- and south-facing walls, which did not usually fall, were equally exposed to this form of vibration, which seemed to come somewhat steeply from below. These walls were rocked longitudinally by the east-to-west or west-to-east waves (instead of swaying transversely), and the effect was to produce a double system of cracks, often going through the whole thickness of the wall, but not throwing it out of plumb. As the wall returned westward from its eastward excursion, a crack formed, owing to the want of tensile strength in brickwork or masonry, the eastern end of the wall being, so to speak, left behind. On the return vibration in an eastward direction, a corresponding crack opened at the west end, and these cracks often cross each other diagonally, as some of my photographs show. Walls in which cement mortar had been used stood much better than those with only lime-mortar. Kingston lime-mortar is generally of poor quality. The defect of all stone and brickwork, however, in respect to earthquake shock, is want of tensile strength, hence the advantage of reinforcing concrete, etc., by strips of metal, which give a fibre to materials otherwise too brittle. The disadvantage of extra height and of top weight were, of course, abundantly in evidence. Any departure from simplicity of form usually brought about additional damage, Gothic gable and classic cornice being almost equally unsuitable in earthquake countries. In face of these restrictions it seems that architects in earthquake countries must rely mainly upon the skilful proportioning of spaces for the production of artistic effect.*

In making a detailed survey of the amount of damage done in Kingston during our second visit, I was surprised to find how much greater had been the intensity of the shock in the eastern than in the western half of the town, as judged by the effect on similar structures. In the crowded business quarter, where the conflagration took place (and which is mostly situate on the west of the town), the damage was much more *en evidence* because the buildings abutted on the streets, and because the weakly constructed shop-fronts fell out

* Since this was written, an interesting paper on "The Kingston Earthquake and Building in Jamaica," by Sir Charles A. Nicholson, Bart. (read at the Architectural Association on January 10), has appeared in the *Builder* for January 18, 1908, pp. 66-70.

from both sides into the street. This took place even where, as in Harbour Street, the shop-fronts faced south or north. In the residential parts of the city, on the other hand, the damage was to a great extent screened by the trees and garden walls, and also by wooden verandahs and balconies, and the full extent of the damage was only revealed by a closer examination.

Dealing with detached houses of similar construction, one may say generally that west of the burnt area the outer east-and-west walls are out of plumb, but often stand, even in two-story brick buildings, and one-story brick buildings are not overthrown. North of, and as far east as the centre of, the burnt area the east-and-west outer walls of the first, which is the top, story of the two-story buildings fell, and in the east of the city the east-and-west outer walls of both first and second stories fell. In the suburb called Bournemouth Gardens, away to the east of the city, the east-and-west walls of one story brick bungalows fell. I found that if a line were drawn from the corner of Harbour Street and John's Lane to the corner of North Street and Wildman Street, the unaided eye could at once detect the markedly greater amount of earthquake destruction on the eastward side (Fig. 5).

I sought to obtain a numerical measure of the difference in earthquake destruction in different parts of the city and suburbs by an examination of about 2600 brick pillars of garden walls and gates. The percentage of these pillars which were overthrown by the earthquake is given in the following table:—

PERCENTAGE OF PILLARS FALLEN.

In streets running from north to south (the order in which the streets come in from west to east).

Princess Street (below North Street) and Orange Street south of the Parade	..	36.0
East Street (north of East Queen Street to the Racecourse)	..	30.0
Hanover Street (from Harbour Street to North Street)	... ..	46.0
High Holborn Street (from Harbour Street to East Queen Street)	... ..	69.5
South Camp Road (from East Queen Street to Goodwin Park)	... ..	62.0

On roads wholly or partly suburban running north and south.

Orange Street (from North Street to Torrington Bridge)	... ..	17.0
Constant Spring Road (from Cross Roads to Constant Spring Hotel)	... ..	4.5
Elletson Road (from Queen Street to Burke's Pen)	... ..	53.0

In streets running from east to west (the order in which the streets come in from south to north).

Harbour Street (from East Street to Fleet Street *)	... ..	52.0
Tower Street (from Fleet Street to Paradise Street)	... ..	35.5
East Queen Street (from East Street to Paradise Street)	..	35.0
North Street (from Regent Street to South Camp Road)	... ..	9.0

On suburban roads running from east to west

Windward Road (from Paradise Street to Bournemouth Gardens)	... ..	40.3
Half-way Tree to Papine Corner	... ..	4.5

* This part of Harbour Street is close to the shore-line, and not much above sea-level

Thus we see that in Orange Street, below the Parade, and in Princess Street, 36 per cent. of these pillars had fallen, whereas in High Holborn Street and South Camp Road the average was nearly 66 per cent., greater by four-fifths than the former.

In the suburbs the brick pillars generally stand separately, not on walls. They are, therefore, somewhat less liable to damage, and there would not be the same difference of liability according as to whether the road faces north and south or east and west. Taking account of these facts, we may compare the percentage of the fallen pillars on the Windward Road (40·3 per cent.) with that between Cross Roads and

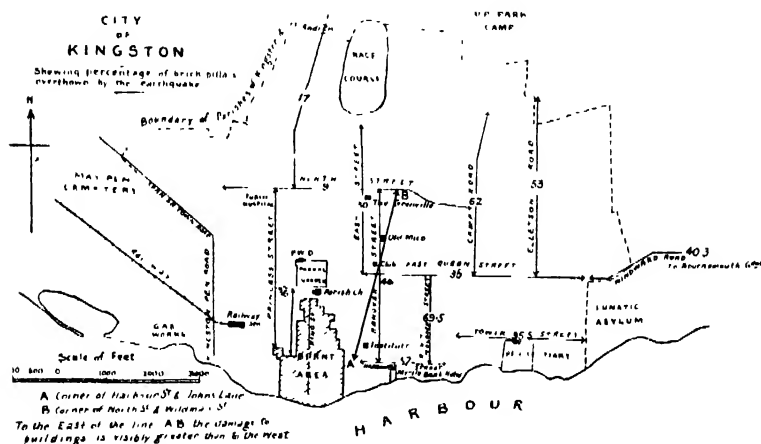


FIG. 5.—PLAN OF KINGSTON, SHOWING PERCENTAGE OF BRICK PILLARS OVERTHROWN BY THE EARTHQUAKE.

Constant Spring (4·5 per cent.), and from Halfway Tree to Papine (4·5 per cent.). The proportion is nine to one. The question may be asked, Is this enormous difference due to the force in the Windward Road being just enough, and that in Lower St. Andrew just insufficient, to overthrow the pillars? I think an examination of the whole table will lead to the conclusion that this is not the explanation of the great difference, and that the *overturning* force of the earthquake on the Windward Road was about nine times greater than on the road from Halfway Tree to Papine Corner.

The overturning force I connect with the short and steep surface waves already described. These appear to be those referred to by Major Dutton,* and called by him epifocal waves. He says of them,

* 'Earthquakes.' By C. E. Dutton (John Murray : 1904), pp. 140 *et seq.*

"There is still a fourth class of earthquake waves, and to the inhabitants of badly shaken regions they are doubtless of the most importance. The normal, the transverse, and the surface waves are seldom seen, though they are more or less felt. The fourth kind are both seen and felt, and are often the most conspicuous and terrifying. They are also the most destructive. They occur only in the epifocal districts of great earthquakes, and never far outside them. . . . Their outward forms, as described by eye-witnesses, exactly resemble flat waves on water. . . . For a long time these motions of the ground were questioned by seismologists, who could hardly believe that such waves could be visible. . . . There is abundant reason for inferring that these epifocal waves . . . have no relation to elasticity . . . ; their lengths are too small, their amplitudes too great, and their speed too slow to be dependent upon elasticity. Their lengths, indeed, are not known exactly, but the inference from the accounts given of them is that their wave-lengths range between 10 and 50 metres, and their heights between 5 and 30 centimetres. Their speeds of propagation are even more uncertain, but are almost surely less than 100 metres per second. These quantities do not fall within the range of elastic wave-motion in any such material as the rocks or soil."

Distant seismograms, while they afford the best measure of the total energy of an earthquake, are, in my judgment, not equally appropriate for deducing the overturning force close to a focus. As in the case of storms at sea, but in a greater degree, the magnitude of the distant swell measures the total energy of the waves at the centre rather than their destructive violence. It is the deep-seated part of the wave-motion which travels far; it is the local surface disturbance which does the damage.

I pass on now to describe the distribution of earthquake damage over the island. I myself closely inspected Kingston, Lower St. Andrew, and Buff Bay Town. I also examined the damage to the town of Port Royal, and visited Gordon Town and Port Antonio, besides paying cursory visits to some other places. For the estimate of damage to other places embodied on the map I have relied upon the evidence of others, most of which I obtained direct from eye-witnesses. I have taken great pains to sift the evidence, and to compare where possible the narratives of different persons. The result is far less satisfactory than a complete survey of the island would have been, but it is, at any rate, a much more extensive collection of such data than has hitherto been published.

I received several narratives from persons who, at the time of the earthquake, were in the mountains between Newcastle and Gordon Town, and between Silver hill and Buff Bay; also from persons at Gordon Town and near Castleton. Their narratives indicate that the shock in these situations was quite comparable in intensity to that

in Kingston. Particularly striking was the experience of a party of tourists, who were blocked by a rock fall on the road leading down to Buff Bay, and had to spend the night in the mountains. The after-shocks were numerous, and each was preceded and accompanied by an appalling noise. The severe landslips about Newcastle and on the north side of Silver hill are evidence of as much force as that required to wreck a house, and the complete wreck of the Gardens House at Gordon Town, of which I took a photograph (Fig. 3), indicates, I think, an intensity greater than that at Constant Spring or near Papine Corner.

The damage at Buff Bay, of which I also show a photograph (Fig. 4), was severe, but the stone buildings do not show evidence of having resisted the shock to the same extent as the brick buildings of Kingston. They collapsed instead of being flung to one side, therefore they probably fell at once; for if they had resisted during an appreciable time, the walls would have got up a swing, and then must have been flung either one way or the other. I estimate the force at Buff Bay as about equal to that at Constant Spring, somewhat less than that at Gordon Town, and considerably less than that in the eastern half of Kingston. The damage to the town of Port Royal was about the same as that in the less damaged parts of Kingston.

If we look at the points marked 10 on the folding map, where buildings fell and where new landslips were formed on hillsides, we see that they may almost all be included between two straight lines joining Harbour Head with Buff Bay Town on the eastern side and Port Royal with Enfield on the western side. The general impression received at the time was that the earthquake at Kingston came from the sea, and the fact recorded by the Port Royal pilot, Mr. Hunt, that his boat lying by Lime Cay was struck before Port Royal, and that the shock was followed (in about one and a half minutes) by a surface sea-wave from the south-west, strengthens this idea. Looking at the band of fallen buildings across the island, the idea suggests itself of a seismic wave coming from beneath the sea rather west of south from Kingston and rushing with scarcely diminished force right across the island, the centre of the wave-front passing close to the Penitentiary, the full force of the wave being felt in the eastern half of Kingston and in the eastern suburbs.

When, however, I plotted out the area where single walls fell, a larger tract than that in which the whole of stone, or all the outer walls of brick, buildings fell, I found that the boundaries of this larger area, where the numbers 9 occur (using the Rossi-Forrel scale of earthquake intensity),* are not symmetrically placed with respect to the

* I have found it convenient to add to the scale a number 11 for the worst-damaged area.

band already referred to; the area where walls fell reaching far to the east of Kingston in the south of the island, and far to the west of Buff Bay in the north of the island. Now, if the band of the figures 10, that where buildings fell, were due to one wave such as I have described travelling far with scarcely diminished force, then we should expect to find the damage symmetrically disposed on either side of the band except in so far as differences of geological strata may interfere. The comparative immunity of damage at the back of Burlington and of Port Antonio could only be explained then by the supposition that the Blue mountains had in some way cast a seismic shadow. Moreover, when I went yet further into the matter and mapped the buildings which had walls, not fallen, but so severely cracked as to be unstable (Nos. 8), I found that here the distribution of damage accorded with the area of fallen walls, and not with that of fallen buildings. The eastern margin of this area is very far from Kingston on the south, but comparatively near to Buff Bay on the north. The western margin follows a somewhat complicated line, and here for the first time we see a marked influence of the nature of the rock. On the great Limestone plateau the damage to buildings is lessened, but in the Chapelton valley, set in the midst of this plateau, the amount of damage was locally much increased upon strata of other kinds. In the absence of any after-shocks traceable by seismograph to this district, I do not feel that we are justified in assuming that there was here a *centrum* or "focus," in the sense of a place where the stress upon the subjacent rocks exceeded their breaking strain, causing a permanent displacement.

Finally, in mapping out the places reported as slightly damaged, *e.g.* by slight cracks in walls and fall in plaster, I find that this is the case up to the eastern coast of the island, but that the extreme south-western corner of the island comes under the category of undamaged, or No. 6. I may say that I only record "undamaged" for towns or groups of houses, among which there are nearly sure to be some of structure such as a strong earthquake would damage. On consulting the map, it will be seen that the western boundary of the places damaged to the extent denoted by 7 runs from west of north to east of south, as do the boundary-lines of 8 and 9, the margins of "serious damage to buildings" and of "fall of walls," respectively.*

(On the north of the island, a "tidal wave" of considerable magnitude was observed at Hope bay, Orange bay, Buff bay, Annotta bay, Sheerness bay, Ocho Rios, and St Anne's bay (that at Port Antonio was quite small), this phenomenon commencing near Buff bay on the east, but

* The line was drawn from Montego Bay to Black River, but, a case of damage having been subsequently reported from further west, the line was shifted to the west, while maintained parallel to its former direction, which is required by the general distribution of damage in the neighbourhood, as shown by the numbers on the map.

extending far to the westward. It may have been produced by sand-slides from the edge of the submarine land shelf shown on the map, which is close inshore all along this coast, and outside which lies water of great depth. The "tidal wave" consisted of a recession of water from the shore, followed by its return in waves. At Port Maria this is reported to have occurred a few minutes before the earthquake.

Off the south coast the breaking, "bird-caging," twisting, and burying of the "Direct" submarine cable all along the line from Bull bay to Yallah's point, indicates great sand-slides along that steep submarine slope, where, moreover, large quantities of detritus are continually brought down by the rivers which rise in the Blue mountains.* There is no cable under the Healthshire hills and away along the coast to the west, but the fact of breakage as far east as Yallah's point shows the great effect of the earthquake beneath the sea far to the east of Kingston on the south coast. The eastern boundaries of considerable disturbance at sea are joined by a line running from Hope bay on the north coast to Yallah's point on the south, and the western boundaries from St. Anne's bay on the north to Port Clarence, where a "tidal wave" was observed, on the south.

Thus again we have boundaries running from east of south to west of north, in conformity with the boundaries of the areas of moderate and slight damage on land, and out of conformity with the boundaries of the area of greatest damage—the area, that is, in which buildings fell.

We shall see presently that the west-of-south to east-of-north direction of the band 10, "fallen buildings," is probably due to the overlapping effect of the western end of a southern focus and the eastern end of a northern focus, and that each focus was probably a long line (not necessarily straight), not a circular area.

The great eastern extension of the moderate intensity of shock on the south of the island we shall see to be due, in part at least, to the eastward position of the southern focus. The great western extension of the area of moderate intensity of shock on the north of the island we shall see to be partly due to the further westward position of the northern focus.

On my arrival in Kingston last May, I found that Mr. Maxwell Hall had published in the *Gleaner* a complete theory of the origin of the earthquake, with a map showing three foci and the direction of vibration of the ground in different parts of the island. This was an abstract of the paper since published under the title of 'Third Report on Earthquakes in Jamaica—the Great Earthquake of January 14, 1907, and the After-Shocks.'† Mr. Hall very kindly offered to show me the

* This detritus drifts westwards before the trade wind, and in June last had already partially repaired a large gap made in the sandy foreshore of Port Royal.

† Government Printing Office, Kingston. 1907.

manuscript of the complete paper, which I studied. On his map the principal epicentre is shown by a circular area $6\frac{1}{2}$ miles in diameter, of which the centre is 7 miles S. 40° E. from the Public Works Department, Kingston; a second epicentre, by a circle 3 miles in diameter, between Enfield and Buff Bay, and a third epicentre by a still smaller circle south-east of Bull Head and south-west of Croft's hill. The axis of the area of greatest intensity, my 10's—marked as VI.'s on Mr. Hall's map—differs very little from that on my map; but the boundaries of the area of serious and slight damage on Mr. Hall's map are concordant with the greatest damage, instead of running, as I have found them, from east of south to west of north.

One of the principal points emphasized in Mr. Hall's report is the contention that the principal vibrations were in all cases at right angles to the direction of progression of the earthquake, and he contends that the reports he received show that in the neighbourhood of each epicentre the vibrations were at right angles to a line joining the place with the epicentre; and that the observations as represented by arrows on the map show a rotation clockwise round each of the three epicentres, and for the far eastern and far western parts of the island a clockwise rotation round the central area where the epicentres are situated. The evidence—contained in the report—on which this important conclusion was based seemed to me to have been treated by Mr. Hall in a manner not quite logical. Thus, to take the case of the observations at Morant Point lighthouse, the evidence is that "it appeared to work from south to north." Now, this evidently relates to the progression of the earthquake, and if the vibrations were transverse they would be east and west, not north and south as shown on Mr. Hall's map. Generally, it seems that either the direction of shaking or the direction of apparent progression has been adopted without discrimination, whereas the very essence of the theory is that they are at right angles to one another. The clockwise rotation, moreover, is obtained by reversing the reported direction south to north (making it north to south) in the case of Morant Point lighthouse, and not reversing the reported direction in the case, *e.g.*, of Annotto bay. I went to Buff Bay as the best means of testing Mr. Hall's theory of transverse vibrations, as well as for the purpose of judging the intensity there. I found, from the careful examination of wrecked buildings, that the line of greatest action was from a little east of north to a little west of south, 15° being the estimate formed of the variation. This is completely at variance with what is required by Mr. Hall's theory, which would make the line of vibration at right angles to what I found from actual observation of fallen walls. At a later date, however, during my visit, Mr. Hall kindly sent me the report of the observations made at Washington* with a

* "The Kingston Earthquake," *Monthly Weather Review*, January, 1907 by Prof. C. F. Marvin.

seismograph consisting essentially of two pendulums vibrating respectively north and south and east and west. Washington lies almost due north from Kingston and Buff Bay. The north-and-south pendulum (that moved by *direct* vibrations coming from Jamaica) began to oscillate first, then the east-to-west pendulum started, and its oscillations (due to *transverse* vibrations coming from Jamaica) were no less than five times greater than the direct vibrations. The author of the note on these observations records the fact as being of great interest, as showing that in this particular earthquake—for the first time, as far as he is aware—the principal vibrations were the transverse waves, those of elastic distortion of the rock, and not the direct waves of compression.

It seemed therefore possible that Mr. Hall's intuition had been correct, although I considered his reasoning faulty and his evidence inadequate; and in the examination of the after-shocks, as recorded by Mr. Brennan's Gray-Milne pendulum-seismograph, I have taken account of the theory that transverse vibrations predominated, as well as of the theory that direct vibrations predominated in Jamaica. The following table shows the after-shocks recorded on the seismograph which Mr. Brennan re-established on January 29. He kindly gave me this list for publication, as well as a description of his instrument, and allowed me to inspect the original records, a series of elongated oval

RECORD OF AFTER-SHOCKS REGISTERED BY PENDULUM SEISMOGRAPH AT THE OFFICE OF PUBLIC WORKS DEPARTMENT, KINGSTON (ARRANGED BY THE AUTHOR FROM MANUSCRIPT KINDLY SUPPLIED BY MR. J. F. BRENNAN).

NO. I. SERIES (*greater in average intensity at Kingston—fewer in number (13)—comprised within a smaller arc*)*.

Coming from				Maximum horizontal movement.	Date	Hour
				Inch.		
S. 85° E.	...	...	...	0.096	April 13	7.8 a.m.
S. 82° E.	...	...	...	0.003	" 24	7.25 p.m.
S. 75° E.	...	...	...	0.023	March 22	6.41 p.m.
S. 75° E.	...	...	...	0.013	" 27	8.56 a.m.
S. 74° E.	...	...	...	0.002	February 3	12.05 a.m.
S. 73° E.	...	...	...	0.006	January 29	1.06 p.m.
S. 71° E.	...	...	...	0.010	February 5	10.59 p.m.
S. 70° E.	...	...	...	0.027	" 22	8.43 a.m.
S. 66° E.	...	...	...	0.004	" 17	9.50 p.m.
S. 65° E.	...	...	...	0.009	January 29	9.20 p.m.
S. 44° E.	...	...	...	0.007	May 3	11.10 a.m.
Mean S. 71° E.	...	...	...	0.018	—	—
N. 85° E.	...	...	...	0.012	August 22	4.25 p.m.

* The solitary shock from S. 44° E. being excepted.

No. II. SERIES (*less in average intensity at Kingston—greater in number (25)—spread over a larger area*).

Coming from			Maximum horizontal movement.	Date.	Hour.
			Inch		
N. 2° W.	...	...	0.002	March 1	5.55 a.m.
N. 1° W.	...	...	0.003	" 11	1.50 a.m.
N. 1° W.	...	...	0.003	April 14	10.30 p.m.
N. ...	...	...	0.004	June 8	4.7 p.m.
N. ...	...	...	0.002	" 29	2.11 a.m.
N. ...	...	...	0.002	Sept. 10	5 a.m.
N. 3° E.	...	...	0.003	February 27	11.40 p.m.
N. 3° E.	...	...	0.002	March 17	7.45 p.m.
N. 3° E.	...	...	0.002	" 20-21	Midnight
N. 3° E.	...	...	0.002	April 9	9.35 p.m.
N. 4° E.	...	...	0.002	March 19	6.10 a.m.
N. 5° E.	...	...	0.006	February 11	5.30 p.m.
N. 6° E.	...	...	0.007	" 11	12.41 a.m.
N. 8° E.	...	...	0.003	" 22	6.15 p.m.
N. 13° E.	...	...	0.003	February 26	8.46 p.m.
N. 15° E.	...	...	0.023	April 9	2.40 a.m.
N. 17° E.	...	...	0.014	March 23 *	11 p.m.
N. 17° E.	...	...	0.007	" 31	7.45 p.m.
N. 20° E.	...	...	0.002	July 28	4.36 a.m.
N. 25° E.	...	...	0.004	March 14	11 p.m. ?
N. 40° E.	...	...	0.007	" 7	6.10 a.m.
N. 45° E.	...	...	0.002	September 11	8.52 a.m.
N. 45° E.	...	...	0.010	October 3	4.9 p.m.
N. 46° E.	...	...	0.003	February 18-19	Midnight ?
N. 49° E.	...	...	0.007	March 5	9.55 p.m.
Average intensity ...			0.005		

The direction of the after-shock of June 13 has been omitted. The maximum horizontal movement was 0.035 inch.

Directions of after-shocks registered by Mr Maxwell Hall's seismograph at Chapelton.

S. 74° E.	...	...	—	June 13
N. 82° E.	...	...	—	" 29

curves scratched by the oscillating needle in the lampblack coating of a horizontal glass plate. Mr. Brennan's work is of capital importance in the elucidation of the earthquake of January 14. All the records present this feature in common—that the greatest excursion takes place on one side of the centre, being apparently the first tilting of the building to which the instrument is attached. The curves, as has been said, are long ovals, so that there is no difficulty in determining with fair accuracy the line of greatest backward and forward tilting of the ground or line of principal vibration.

* At Buff bay, the strongest shock since January 14; also somewhat severe at Annotto bay.

As will be seen from the table, these after-shocks belong to two principal groups: one in which the vibrations are along lines rather south of east to rather north of west, and *vice versé*; and another more numerous group of shocks, generally less violent at Kingston, whose vibrations are along a line from east of north to west of south, and *vice versé*. The principal excursion of the former group was westward of the point of rest of the pendulum, the principal excursion of the latter was south of the central point.

Now, the general line of vibration of the less numerous set of after-shocks, which were the stronger at Kingston, was the same as the line in which buildings chiefly rocked in Kingston, and the line in which the walls fell. This is one of the most salient and well-established points relating to the earthquake, and I have no hesitation in stating, as a sure deduction, that these vibrations were repetitions of those which destroyed Kingston. Were they transverse or direct? If the former, as the Washington observations suggest and as Mr. Hall's scheme requires, then they came from west of south or from east of north.

Observers in Kingston on January 11 agreed that the path followed by the destruction was from the seaward, not from landward, from a southerly, not a northerly direction. On the theory of transverse vibrations, therefore, the central line of this set of after-shocks (and therefore, by inference, of the shock which destroyed Kingston) was S. 19° W. or thereabouts from the P.W.D., Kingston (Fig. 6). The distance at which the focal line (due to an originating fault, to adopt the usual hypothesis) would be situate cannot be accurately determined, but as soundings were unchanged for 5 nautical miles south of Port Royal, along the south channel, I should provisionally select a position between this point and the southern break in the Panama cable, which is shown on the map.

If this be really the direction from which the stronger but less numerous set of after-shocks came, then it follows as a necessity that the other group came from a little south of east or a little north of west for the P.W.D. at Kingston. The rapid falling off in intensity of the earthquake to west of Kingston negatives the latter alternative.*

Drawing the lines eastward as in Fig. 6, we see that several of them pass through the subsidences recorded by Mr. Charlton Thompson, harbour-master, in the eastern part of Kingston harbour. These subsidences of some fathoms near Rock fort, and that at Harbour head,† are

* See, however, *Pop. Sci. Monthly*, vol. 70 (1907), pp. 385-403: Prof. Chas. W. Brown, "The Jamaica Earthquake."

† Extract from the *Jamaica Gazette*, February 14, 1907. "I surveyed the fore-shore from the wharves up the northern shore of the harbour to Harbour Head. The soundings off the wharves and up to eastward of the Lunatic Asylum have not been materially altered, but close to the shore from Rockfort Gardens and under the

the most considerable physical changes recorded as the result of the earthquake, and they are but a short distance from Kingston. The directions of some of the shocks are also consistent with additional origins of disturbance near Bull bay, not far from which there is a suspected case of a change of soundings amounting to many fathoms.

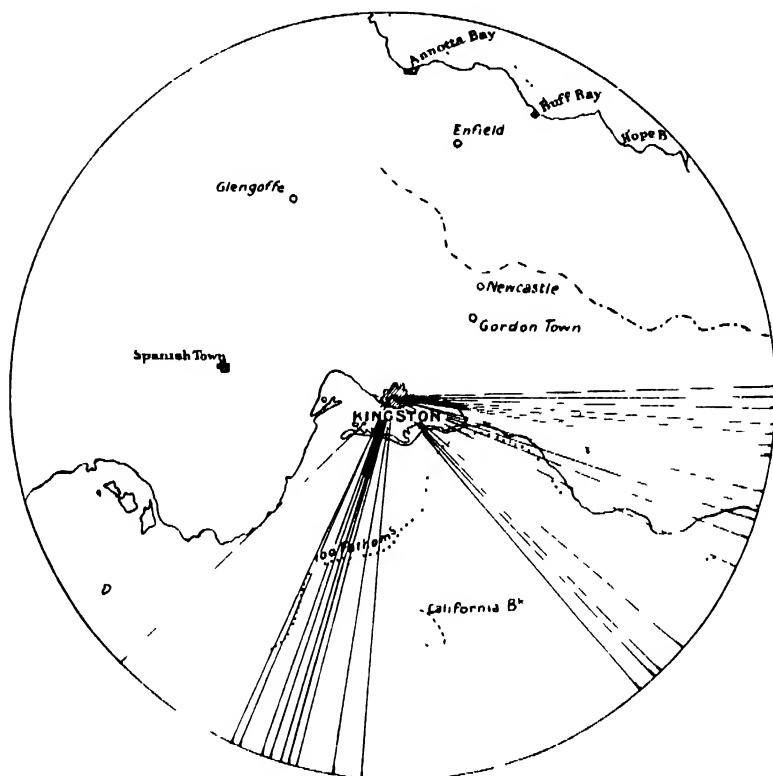


FIG. 6 DIRECTIONS FROM WHICH THE AFTER-SHOCKS CAME, ON THE THEORY OF TRANSVERSAL VIBRATIONS.

If Kingston were wrenched by transverse vibrations, then the first and by far the most important focus of the Jamaica earthquakes was S. 19° W. of Kingston, probably a good many miles out at sea; and the second focus was of merely local importance, mostly situate near the

base of Long mountain there is in places considerable subsidence, also at the eastern edge of the Palisadoes, where I got 4 fathoms of water over mangrove bush which had hitherto been above water; here there are many cracks and fissures in the sand. The soundings further from the shore and through the centre line of the harbour are practically unaltered.

“(Signed) CHARLTON THOMPSON,
“Harbour Master.”

coast of the eastern part of Kingston harbour. This theory is in accordance with the Washington observations, and accounts for the distribution of the area of fallen buildings, if we assume that the earthquake wave travelled far with slight diminution of intensity in its line of direct propagation. On the other hand, it is out of accord with the general distribution of boundaries of moderate and slight damage in the island.

Towards the end of my second visit to Jamaica Mr. Maxwell Hall erected a pendulum seismograph at Chapelton. It recorded the considerable after-shock of June 13, vibrating in a line S. 74° E. and N. 74° W. This could not be due to transverse vibrations from either of the positions which I have deduced for the foci on the basis of that theory. Unfortunately, Mr. Brennan's seismogram of this shock was rendered imperfect by the needle having left the plate. I was unable to agree with Mr. Brennan's opinion that the vibrations were from east of north to west of south, and thought they were from south of east to north of west. Up to the time of writing only one certain cross-bearing from the records of both seismographs has been published, viz. that of the after-shock of June 29, very slightly felt at Kingston. The direction at Kingston was north to south exactly; that at Chapelton was S. 82° W. and N. 82° E. On the theory of transverse vibrations, these two records are hopelessly at variance, as can be seen from an inspection of the map; but on the theory of direct vibrations they are in harmony, and their point of radiation is shown by the position marked A upon the map. The instrumental evidence, therefore, though not abundant, is clear and precise in its indication that the vibrations of the after-shocks were direct. It is singular that Mr. Hall should have assumed this to be the case all along, while considering the main vibrations of the principal shock to be transverse. If any conclusions as to the original shock are to be drawn from the after-shocks, it can only be because they are repetitions of the original, and such I shall throughout assume them to be.

Reasoning now on the supposition that the vibrations of the after-shocks were direct, not transverse, we will proceed to deduce, as nearly as the data allow, the positions of the foci of the earthquake, giving due weight at the same time to the distribution of damage in the island.

As I have said, the set of after-shocks which vibrated from S. 15° E. to N. 15° W. are certainly repetitions of the shock which overthrew Kingston; they were the strongest after-shocks at Kingston, and the vibrations coincide in direction with the fall of buildings there.

The greatest, and apparently the first, excursion of the needle was to the west,* but the distribution of intensity shows that the centre of

* This fact, combined with the experience of people in the streets of Kingston on January 14, 1907, suggests that the tilting of the ground was first a slow heeling over to the west, followed by a sharper subsidence, causing a more sudden heeling to the

activity could not have been west of Kingston. Therefore, on the direct theory, the shocks came from the eastward, and their directions are shown in Fig. 7. Several of them pass through the positions of the subsidences in the east of the harbour, which were established by Mr. Charlton Thompson, so that the function of these subsidences, and of the occurrences off Bull bay, as indications of a probable focus, is indicated equally well on the direct and on the transverse theories.

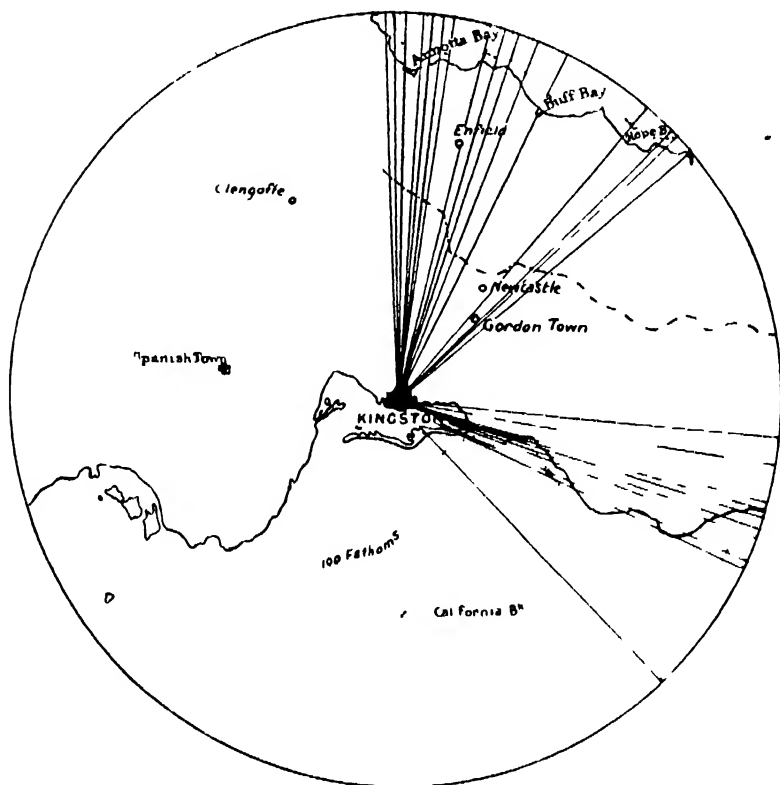


FIG 7 - DIRECTIONS FROM WHICH THE AFTERSHOCKS CAME, ON THE THEORY OF DIRECT VIBRATIONS

We have seen that, on the direct theory, in the case of the first set of after-shocks the direction of progression must have been from east

east. The process of subsidence at the epicentre may possibly have been as follows, viz first a swelling up, as the packed rock material at and near the surface assumed a more open order, and then a subsidence into the new positions. Such is the process which Sir George Darwin observed in his experiments upon landslips, the explanation of which is provided by Prof. Osborne Reynolds' discovery of the property called *dilatancy*.

to west, *i.e.* towards the direction of greatest travel of the needle. In the second set of after-shocks the needle moved more to the southward, and they must be assumed, therefore, to have originated to the northward. The lines of their direction from Kingston are shown upon Fig. 7. There are no subsidences or faultings yet reliably recorded on land as a result of the great earthquake to show how far distant from Kingston along these lines were the foci, but we have, in the case of the after-shock of June 29, the cross-bearing from Chapelton, which cuts the direction from Kingston at the position shown on the folding map by the letter A. Some approximation to the probable distance of other points of origin of disturbance are afforded by the map of distribution of damage.

This direct theory of vibration of after-shocks is demanded by the definite, though scanty, evidence of the directions of vibration from Chapelton, but the argument is strengthened by the way in which the distribution of earthquake damage throughout Jamaica is accounted for by this arrangement of foci, and are, on the other hand, violated by the arrangement of foci required by the transverse theory.

Thus on the transverse theory (Fig. 6) the Jamaica earthquake was mainly due to a focus which sent out *fewer* after-shocks than the minor focus. The after shocks which were felt most strongly at Kingston came from the more distant centre; the more numerous set came from a relatively short line of country and the less numerous from a long line. Finally, the after-shock of March 23 was felt more severely at Buff bay than at Kingston, although, on the transverse theory, more distant from the former place. Several of the early after-shocks recorded before the erection of seismographs were felt as strongly at other places as at Kingston, *e.g.* the shock of Tuesday, 15th, about mid-day, which brought down a cracked wall at Port Antonio on the north east of the island. These facts are not satisfied by an arrangement which makes the main part of the Jamaica earthquake come from several miles south, and somewhat west, of Kingston.

Again, we see that on the positions which must be assigned on the "direct" theory of after-shocks, in harmony with the distribution of damage, probabilities are further satisfied in that the after-shocks more strongly felt at Kingston are those of the group originating near that place. Of the northern set of after-shocks, those felt most strongly at Kingston probably originated nearer to Kingston, and are probably repetitions of the shock which was principally responsible for the damage at Gordon Town and Newcastle.

The northern set of after-shocks, which are the more numerous, come also from a longer line of country. The original shock, of which they are repetitions, may have been equal to the shock which wrecked Kingston, and its central position in the island accounts for the fact

that the general distribution of damage seems to depend as much on the northern as on the southern focus.

Fig. 8, which shows the direction in which walls and buildings fell, lends support to the theory of a southern focus near the coast, and northern focus near the centre of the eastern portion of the island, assuming, as I shall now proceed to do, the correctness of the direct "theory" to be established. The directions for Kingston, Port Royal, Halfway Tree, Stony Hill, Constant Spring, and Buff Bay were determined by myself. The Kingston direction is, of course, the best established, being determined from a larger number of buildings. The directions

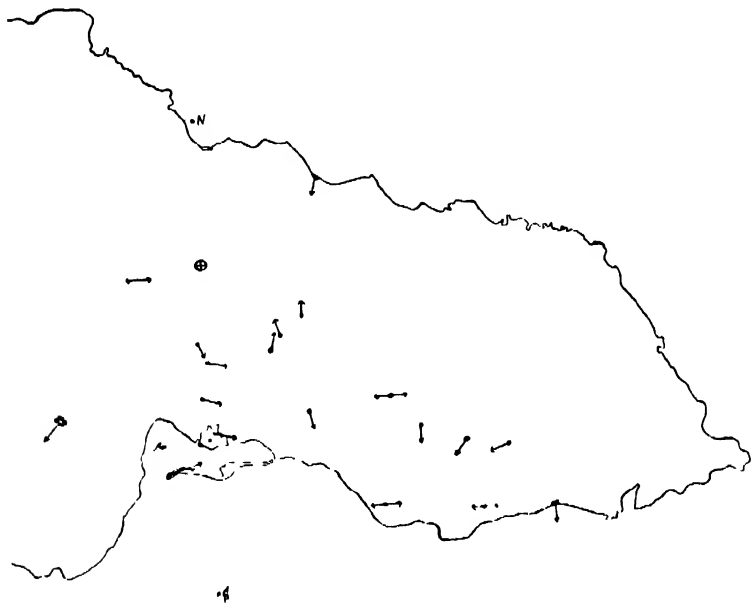


FIG. 8.—ARROWS SHOWING FALL OF BUILDINGS.

for places in St. Thomas are mostly from observations by Mr. Pearson, who, at the request of Mr. D'Aeth, Assistant Director of Public Works, made a tour of inspection with the special object of investigating this point for my information. In Kingston, as I have made clear, the buildings fell towards the probable centre of local disturbance, near the shore of the eastern harbour, and I shall assume, therefore, in absence of contrary evidence, that the same rule was followed elsewhere. It will be found that in Lower St. Andrew and in St. Thomas the directions converge to an elongated ellipse, the axis of which is roughly from Rockfort to Yallah's Salt Ponds; but that, as far as the evidence goes, the buildings in the triangle—Newcastle and Silver hill, Glengoffe and Buff Bay—fell towards an area, the shape of which

remains at present indefinite, within that triangle. The observations here are, however, less numerous and less reliable than in the south. Situated within the same triangle, at the position marked A upon the map, is the converging point of the directions of the after-shock of June 29 recorded both at Kingston and Chapelton. Assuming the seismograms to be accurate, this gives the position of almost the most westerly point of the northern origin of after-shocks, which I shall assume for the purpose of this paper, to be the same as the northern origin of the earthquake. It is situated in the valley of the Ginger river, on the southern side of the western portion of the central mountains on the "Metamorphic" formation of Sawkins' * map, which is the "Conglomerate and Tuffs" of Hill's † map.

If the focus of the earthquake be related in position to the surface boundaries of the geological strata, then (reasoning from the distribution of damage without reference to the above radiant point) it appears not improbable that the cause of the northern part of the earthquake was a relative movement along the north-west to south-east line of junction of the Carbonaceous shale and the Metamorphic series (using Sawkins' terms), that is to say, the Richmond formation and the Conglomerates, using R. T. Hill's nomenclature. That such disturbance has taken place in the past is indicated by the fault at this junction, which is shown by Sawkins not far from Enfield, and bearing north about 12° east from Kingston. Mr. Hall has already drawn attention to the existence of this fault in connection with the earthquake. Unfortunately, it has not so far been inspected, so that we have no evidence that there has been a further shift. The considerable shocks from north 40° , 46° , and 49° east, Mr. Hall traces to the fault on the Spanish river, but in this case there is not only an absence of direct evidence, but the indirect evidence of the distribution of damage does not support the supposition, for scarcely any damage has been reported from this region of the island.

The band marked 10 on the map—that in which buildings were overthrown—crosses the island from north to south with a cynical disregard for variations of geological strata (Fig. 9). This fact is probably due to its not being really the track of a single seismic wave, but to the presence of a second centre of disturbance halfway across the island. When, on the other hand, we examine the distribution of damage beyond the neighbourhood of the two regions of original disturbances, we find one well-marked connection with the arrangement of rock, viz. that the eastern boundary of the great White Limestone plateau is generally the western boundary of severe damage. This seems to be due to a

* 'Reports on the Geology of Jamaica,' by James G. Sawkins, F.G.S. (Mem. Geol. Survey). 1869.

† 'The Geology and Physical Geography of Jamaica,' by Robert T. Hill Cambridge, Mass., U.S.A. 1899.

Scale 1 1,500,000

Scale 1 1,500,000



FIG. 9.

mechanical reason, viz. that foundation on this resilient rock helps to make a building earthquake-proof. Thus Higgin town on the Limestone plateau was undamaged, whereas buildings on deep alluvium at Cave valley and Greenock close by were wrecked. In the east of the island hardly any damage was reported from the limestone region of the John Crow mountains. In St. Thomas and Portland some of the damaged houses, which a small-scale geological map would indicate as being on

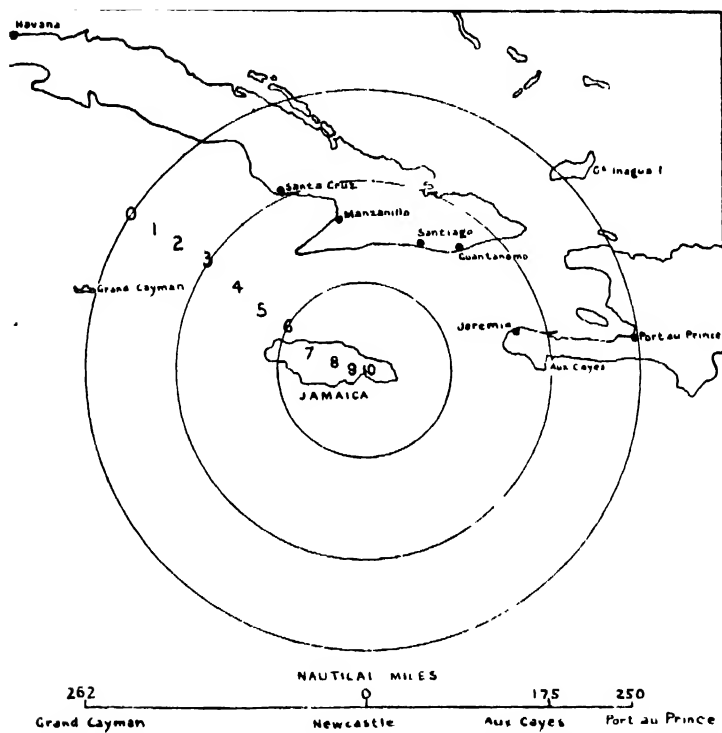


FIG. 10 —EXTENT OF THE JAMAICA EARTHQUAKE AS A SENSIBLE SHOCK (ROSSI-FOREL SCALE).

the White Limestone, are, in fact, situate on narrow bands of alluvium close to rivers.

The shocks from the two foci of the earthquake of January 14 were practically simultaneous, so that they must be ascribed to a common cause, but what was the physical connection between the two areas, causing them to be simultaneously affected, has not yet been discovered.

The earthquake was felt in Haiti (Fig. 10), at a distance of 173 geographical miles from Newcastle, but was not perceptible to human senses at a distance of 250 miles in Haiti, or in Grand Cayman island,

260 miles to the west. The great strength of the shock near the two foci, combined with the comparatively small radius of perceptible shaking, suggests that the earthquake was not deep seated.

In concluding this outline of my investigation of the Jamaica earthquake of January 14, 1907, conducted at my own expense, and without special facilities for prosecuting the work, I will venture to state what I think might properly have been done by the Home Government in this matter. A commission of three should have been despatched at once to the island, composed of a field geologist, an expert in building construction, and an hydrographer. The neighbourhood of the coasts should have been re-surveyed, a complete record made of all damage to buildings, simple seismographs set up in different parts of the island, and an exploration made for new faults, or movements of old ones, particularly in the somewhat difficult country of the central part of the eastern third of the island, which is at the same time mountainous and in many places thickly wooded. Three months would probably have sufficed for the observations, and another three months for preparing the report. The guidance which such a report would have furnished for selection of methods of building, and perhaps of sites for houses, in Jamaica, would in itself have more than repaid the expense, and the report would have been a valuable guide in other parts of the empire which are situate in seismic areas.

I am indebted to many persons for information, and desire to acknowledge my obligations to Mr. J. D'Aeth, Mr. J. F. Brennan, Mr. Frank Cundall, Mr. Maxwell Hall, the Rev. F. L. King, Sir Charles Nicholson, Bart., Mr. Charlton Thompson, and the officials of the West India Direct, and of the West India and Panama Telegraph Companies.

SCALE OF EARTHQUAKE INTENSITY EMPLOYED FOR THE FOLDING MAP AND FOR
FIG. 10.

11. All outer walls of brick houses built with lime mortar overthrown. Complete collapse of stone-built country houses.

10. Outer walls of upper story of brick houses built with lime mortar overthrown. New landslips on hillsides. New springs.

9. Some brick and stone walls fallen. Old landslips enlarged.

8. Cracks in walls sufficient to render them insecure.

7. Slight cracks in walls and fallen plaster.

6. No damage to buildings, but shock recorded as of a severity unusual in Jamaica.

5. Moderate shock, felt generally by every one.

4. Feeble shock, felt by persons in motion.

3. Very feeble shock, but strong enough for the direction or duration to be appreciable.

2. Extremely feeble shock felt by a small number of persons at rest.

1. Microseismic shock, felt by an experienced observer.

The arrangement of localities according to the class of damage described under readings 11 to 6 was made by the author solely from the consideration of facts and

circumstances in Jamaica, but it was found that the scale was concordant with that of Rossi-Forel, except that in the latter the number 10 does duty for both the 10 and 11 of the author.

The descriptions for the numbers 5 to 1 are extracted from the Rossi-Forel table, as given by Dutton in his book on 'Earthquakes' (Progressive Science Series). One of these numbers (3) corresponds with the intensity observed in Eastern Cuba and in the western peninsula of Haiti.

The PRESIDENT: It is with sincere pleasure that we shall once again hear Dr. Cornish address us upon the subject which he has made especially his own, which he has most appropriately christened Kumatology, or the science of waves, and to which he has devoted great ability and most careful attention. During the last ten years Dr. Vaughan Cornish has frequently addressed us (and has also contributed valuable articles to our *Journal*) on that interesting subject, and has set before us his observations and his deductions on the action of waves in the atmosphere, in the hydrosphere, and in the lithosphere, or, in other words, in gaseous, liquid, and solid matter. Under the last head I, of course, include sand-dunes, sea-beaches, and snow-waves. Many of you will remember that Dr. Vaughan Cornish visited the Nile for the purpose of examining the sand-waves of the desert which border upon the valley and delta of the river, and that he also went to Canada to investigate the phenomena of snow-drifts and snow-waves; but I do not for a moment suggest that he went to Jamaica in order to examine the action of earth-waves, which he encountered there in a formidable shape, and which he is going to describe to us to-night. As regards his investigations in the hydrosphere, perhaps the most interesting that he has laid before us was in relation to that remarkable tidal wave in the river Severn, which is known as the Severn bore. To those who have not followed Dr. Vaughan Cornish's investigations as a whole, I would recommend the perusal of an abstract, which appeared in our *Journal* for June, 1899, of an address which he had given us a few months before on his new science of Kumatology, and in which he dealt generally with the subject. One great merit in Dr. Vaughan Cornish's observations, if I may venture to say so, has been that he has fixed those observations, wherever it has been practicable, with the aid of a photographic camera, and even the Jamaica earthquake did not make him forget that valuable companion. I am quite sure you will understand that it would be inappropriate for our lecturer to attempt to-night to enter into the more technical sides of his very interesting subject. He is reserving these for an address to the Research Department of our Society, where we can have a full discussion, that Department being, as you know, open to all Fellows of the Society, as well as to eminent and recognized scientific observers from outside. I will now invite Dr. Cornish to give his address.

Dr. STRAHAN: I must confess to having had at first some misgivings as to the propriety of bringing an account of an earthquake before a Society whose function is the study of geography, but I was somewhat reassured when I came to reflect that earthquakes are important factors in the determining of coasts, in the alterations of the level of the land, and in the formation of mountain chains. We have heard a little, and we hope to hear a great deal more, upon the cause of this earthquake. The fashion now, if I may use the expression with regard to scientific hypothesis, is to find an originating fault for every earthquake, and I am bound to state that in my opinion that theory has been sometimes forced beyond its legitimate limits. I do not mean to say that a fracture, such as a fault along which the strata have been misplaced, may not have been the cause of many earthquakes, but I think that the wrong fault has been credited with the mischief in several cases.

In the first place, many of the faults which are shown upon our geological maps, and which are familiar features to all geologists, are faults of very ancient date indeed. They are defunct in the sense that they came into existence when the world was young, and that they have been inactive during many geological ages. Unless there is some evidence of renewed movement along such faults, it is hardly fair to credit them with having caused the earthquakes of to-day. As another example, I may mention a case of a somewhat different kind which took place recently. It will be within your recollection that in South Wales, some few months ago, there was an earthquake of considerable intensity. An account of it was published, and the isoseismic lines were drawn with what seemed to me an astonishing regularity and certainty. The originating fault also was laid down exactly, the towns by which it passed were named, and, in fact, the account of it as published was circumstantial and bore upon it the aspect of truth. But it so happened that the region which it was supposed to traverse is honeycombed with old coal-workings, and in that region every fault which exists is perfectly well known: I am able to state as a fact that no such fault exists along the line described. One comment I should like to make, and I think it has occurred to everybody in this room. We always have been given to understand that an earthquake is one of the most terrifying experiences through which a man can pass, and I think there is nothing that we have seen or heard to-night to dispel that idea. The obligation under which we are placed by one who has passed through the ordeal, and has been able to preserve for us a reliable record of what took place during that wonderful moment and after, is great.

Sir CHARLES NICHOLSON: I did not come at all prepared to say anything to-night. I went out to look at some of the buildings, with a view to suggesting how they should be reconstructed. From the architect's point of view, the old buildings in Jamaica were constructed without much foresight as to the possibility of earthquakes. Two hundred years ago there was a prosperous town at Port Royal, which is the spit of land now enclosing the harbour. This town was shaken down by an earthquake, and the people of Port Royal went and settled at Kingston. Having got to Kingston, they made up their minds that they were perfectly safe; so they proceeded to build rather handsome Queen Anne buildings with good thick walls, but not very choice materials. They never thought that the earthquake was coming, and it didn't come for two hundred years; at last it did, and many of the buildings came down. But there are some buildings in Kingston which did not come down, even in the central part of the town. In one instance I think Dr. Vaughan Cornish may bear me out. He probably noticed the tram company's power-station. That is a building which has no partitions or internal supports of any kind, it is a brick and cement building. Other brick buildings in Kingston, such as the parish church, were built with very poor lime-mortar, and these buildings collapsed, at any rate in the parts of the town which were most affected by the earthquake; but the buildings did not collapse if they were built in cement-mortar. By the quay, again, there is a large customs shed, a considerable-sized room, about as long as this theatre, unsupported by buttresses or columns or internal walls, but it was built of cement concrete, and stood without a crack. There is only one other thing I should like to say, and that is, that before going out to Jamaica, and on the way out, I read a good deal that had been written by Prof. Milne about the behaviour of arches, and I was surprised to see how very many arches in Jamaica stood without any serious injury; there seems to be an elasticity in arched construction, and an arch gives from right to left, and so minimizes the shock.

Mr. OLDHAM said that, as he had not expected to be called upon to speak, he could only mention some of the various ideas which passed through his mind as he listened to Dr. Cornish's paper. He would put first the fact that this Jamaica

earthquake, although, as Dr. Cornish remarked, a great earthquake, was not a very great earthquake. It did not compare, for instance, with the 1897 earthquake in India, or, to come nearer to them in time, with the Valparaiso earthquake, which caused vastly greater damage. And in the minor question of the interruption of amusements, Dr. Cornish had mentioned that four months elapsed before there was a dance in Kingston; but the Valparaiso earthquake took place more than five months before the Jamaica one, and he had been informed only a day or two ago that the after-shocks were still frequent, and severe, so much so that nobody had ventured to suggest the possibility of a dance. This earthquake had suggested some very curious seismological problems. When the first accounts came of the earthquake, it appeared to be one of those very localized earthquakes, like that of Casamicciola in 1883, which are extremely intense over a small area, and are hardly felt outside that small area. Later on accounts came in which showed that this interpretation needed to be modified; cables were fractured, not close in shore, but at distances of 5 and 8 miles away from Kingston, and Mr. Maxwell Hall's report, as well as Dr. Cornish's account, showed that the earthquake was not so localized in Jamaica as at first appeared. Moreover, the long-distance records in Europe and elsewhere were very insignificant, in comparison with the magnitude of the earthquake at its centre, or what is called the *magaseism*. There was another word which had been introduced of late years, namely, "*teleseism*;" though originally it meant merely a long-distance record of an earthquake, he was not sure that it did not represent more than that, or that the disturbance registered at a distance from the origin of an earthquake was the same thing as that felt on the spot. It is quite certain that many great *macroseisms* give rise to very small *teleseisms*, and he was investigating the possibility of the converse. This was difficult to establish, as it was only for the last few years that records were available to work on, but the disturbance represented by the *teleseism* seemed to be distinct from the superficial disturbance, or *macroseism*, which causes damage near the origin. He would not discuss Dr. Cornish's theory of the origin of the earthquake, because that subject would come up again at a future meeting. Finally, with regard to the question of damage to buildings and earthquake construction. This had been studied and reported upon in the case of several of the great earthquakes which had lately been experienced, and the one thing that had come out prominent above all others was that, if you wanted to make an earthquake-proof building, you must put in sound material and good construction. In San Francisco not one soundly built building was seriously damaged. In Calabria, where so many lives were lost and so many buildings were destroyed, Prof. Ricco, in his report to the Italian Government, attributed the greater part of the damage to bad construction and faulty material. According to him, these were rarely good, occasionally passable, often bad, but usually sinful; and, to judge from Dr. Cornish's photographs, it seemed that very much the same might be said of Kingston. Like the last speaker, he had been struck by the standing of the arches, but was not sure that the explanation offered was the correct one. An arch was in itself the very worst form of construction possible to resist an earthquake, but an arch could not be built of bad material and bad workmanship. Where arches were put into a building, good material and good workmanship were used, whatever might be done in the rest of the wall, and so when the earthquakes came, it was possible that the arch might stand, while the walls, built of poorer material, were destroyed. There was one peculiarity about the photographs, in that what Dr. Cornish called the partition walls often stood and supported the roof, while the outer walls fell down. He would like to ask whether these were partition walls as we understood the words. An English house is generally built with the partitions weaker than the outer walls, but the

photographs suggested that in Kingston the former often constituted the essential framework of the building, and that the outer walls were additions built of inferior material. If that were the case, it would be easy to understand how they might be thrown down, while the central framework remained standing.

Dr. LONGSTAFF: It was my good or bad fortune to be, like the lecturer, an unwilling spectator of the earthquake in Jamaica. I was thinking of going into the Conference Hall, merely waiting for the speaker to sit down, when I heard a noise and felt a shaking, and said, "Hallo, I am in for the earthquake which I have always wished to experience." There was a noise, as though the tiles were coming down, but I did not see any tiles come down. I thought I would go out, because if there were a panic, I should be thrown down. I went to the top of the staircase, and went about halfway down, when I thought I was pushed from behind. I finished the descent head first on my back, and found myself standing on my head in the middle of the street, but picked myself up not materially the worse, and thought what a very trivial earthquake that was to be in. To prove how little it affected the people, I may say they came out of the building two by two, and a gentleman came up to speak to me. I said, "Hallo, you have been down, as I have been; if you will dust my coat, I will dust yours." I had some difficulty in coming down to the place where I found my wife. She was going up a staircase close to a big window, and was struck with the astonishing brilliance of the day. At that moment she felt the sensation of a very heavy vertical blow from underneath upon the stairs. She grasped the situation at once, and turned round to go out. The whole place was shrouded in darkness from the quantity of dust; the wall to her right hand was waving backwards and forwards, and bricks were falling from the top of it. She went through a volley of bricks, almost feeling her way, and down two or three steps into the street. I visited the building a few days afterwards; the whole of the upper story of that building had fallen outwards; my wife had apparently gone through three or four cart-loads of bricks. Now, after this personal experience I cannot but recount the experience of a man, Mr. Abel, whom I met afterwards. He was at the Constant Spring Hotel, watching a lawn-tennis match. He had had a sunstroke in India some years before. He said that the lawn appeared to be blown up and down in waves, and he said, "Gracious me! I have got the sunstroke again!" Then he raised his eyes to one of the stonework tiers of the hotel; he saw an immense crack that extended from the bottom of the building to the top, and it was sufficiently wide at the top that a man on horseback could have ridden through it. The lecturer has made no allusion to the remarkable fracture of the cable about 11 miles south-east of Port Royal. Now, that is a very extraordinary thing which has to be accounted for somehow or other. Then there is another thing which must be borne in mind, and it is especially interesting of this earthquake, for, as far as I can see, the maximum intensity was somewhere between or near the south-eastern corner of Kingston, or somewhere thereabouts. Well, that is extremely near Port Royal, or where the maximum disturbance occurred in the earthquake two hundred years previously. I think that fact is interesting when considered in connection with the question of faults. Two or three days before the earthquake I was walking through the streets of Kingston, and I said, "Good gracious! how they do need a Building Act here! What a shockingly built city it is! how bad the material!" and I think the account of the enormous amount of dust raised by the earthquake is almost a proof of the badness of the mortar. Now, with reference to arches, I notice that semicircle arches stood the earthquake very well, but Gothic arches stood it badly. I am sorry Dr. Cornish did not get to Spanish Town. It is very interesting, as containing buildings of all sorts of descriptions of strength, and being a considerable distance off, and where the

damage done was considerable, but yet very little was thrown down. We are, therefore, better able to see the lines of force and what happened; and one curious thing there is, that the maximum line was north and south, yet one thing that was noticed very much there is that the north and south walls had gone at the junction to the lateral walls. The lateral walls had stood, and the north walls that had been thrown down had been broken off at the ends. The tensile strength of the stonework used in Jamaica is very poor—indeed, almost poorer than brickwork. It is a soft calcareous limestone, practically coral rock, which is very often built in irregular shapes, and the lines of fracture of the earthquake will go from top to bottom through the stone. Brickwork appears to be better than stonework, and, of course, wood is better than either. A brick building is both heavy and has slight tensile strength, whereas a wood building is light and has considerable tensile strength; and therefore it seems to me that you want to combine as little weight as possible with the maximum of tensile spring. A further question arises, which the lecturer did not allude to, and that is, what should any of us do in the event of finding ourselves in a building when an earthquake took place? I have great confidence in saying, if you are in bed, stop in bed, unless you feel inclined to get under the bed. You can practically do nothing—you must wait till it is over; but the danger in some cases is greater than in others, and the danger is greatest of all just outside your own front door. It is better to stop inside a building—you may be killed, and you may not.

The PRESIDENT: I do not fear, with Dr. Strahan, that we may perhaps have been going beyond our province, for geography deals with the surface of the globe and with ourselves who live upon it. Earthquakes will insist upon coming to the surface—that is the worst of them—so that we must deal with them geographically. I am impressed with a melancholy coincidence. We all remember the story of the lady who said how providential it was that most great cities had rivers flowing near them. It struck me, while looking at Dr. Cornish's valuable map, that it was the reverse of providential that Jamaica's chief city happened to be close to the centre of the area of disturbance, thus resulting in a deplorable loss of life. We tender to Dr. Cornish our most cordial thanks.

Dr. CORNISH: At this late hour I will not detain you with any lengthy reply to the various interesting remarks that have been made by different speakers. I compressed my account as much as possible in order to allow ample time for those who were to follow, and many of the points which are raised are, in fact, answered to the best of my ability in the written paper, to which I will venture to refer you.

The following discussion took place at the meeting of the Research Department:—

Mr. R. D. OLDHAM complimented Dr. Cornish on the acumen of his observations and the importance and interest of the observations which he had gathered together in his first attempt at seismological research, but was unable to agree with Dr. Cornish in some of his deductions. As regards the "double-barrelled" origin of the earthquake, the concept seemed to him out of date; the old mathematical hypothesis of an origin so limited in size that it might be regarded as a point had long been abandoned, and the origin of great earthquakes recognized as a more or less extended fissure, to use the nearest word available. A very striking paper on earthquake origins, by Colonel Harboe, has showed that these fissures very probably ramify over a much more extensive area than used to be supposed, and are probably coextensive with the area of sensible shock. In view of this explanation, the supposition of more than one focus becomes modified into that of a single extended origin with a varying intensity of disturbance in different portions. The discussion as to whether the motion of the wave-particle was in the direction of the wave path, or transverse to it, seemed superfluous in

the face of our knowledge that it could be neither. The direction of overthrow of pillars was no longer accepted as an indication of wave-motion; it approximately coincided on the average with that of the direction of maximum amplitude and acceleration, but arguments derived from data of this character had to be used with great caution, and were especially uncertain when derived from isolated cases of overthrow.

Dr. CORNISH: Mr. Oldham says that experienced seismologists have long abandoned the theory that the origin of an earthquake is a point. He says that, for convenience, they call it a fissure, and that it has considerable extension. I have not described the foci of the Jamaica earthquake as points, but as long lines not necessarily straight, which is precisely the form which Mr. Oldham says is favoured by experienced seismologists, and I have avoided the use of the term "fissure," of which he does not wholly approve.

But Mr. Oldham then suggested that earthquakes do not, in fact, come from any such definite origin, but that there is a large area over which the intensity is great, shading off, as I understand him, gradually into the surrounding area without anything to indicate an origin possessing even the shape of a fissure. I must traverse his implication that this is a view at all universal among experienced seismologists, or that an assumption to the contrary is antiquated. Prof. J. Milne, for instance, at the meeting of Section E of the British Association in August, 1907, attributed the principal part of the Jamaica earthquake to a fault, which he spoke of as "the main fault," and for which he specified a definite direction. Dr. Charles Davison, in his well-known papers upon recent earthquakes, frequently traces their origin to a definite line of faulting. Right or wrong, therefore, the treatment is neither antiquated nor contrary to the methods of experienced workers. Moreover, in the case of the great Californian earthquake of 1906, commonly called the San Francisco earthquake, it is matter of common knowledge that the effects grouped themselves about a long line of fracture plainly visible on the surface, and the investigators have further stated that this is the line of a previously known geological fault.

With regard to the connection between the direction of after-shocks and that of the main shocks, it will be seen, on reference to my paper, that I have made no assumption of inevitable coincidence; but when Mr. Oldham says that, although due to the same original cause, it is illogical to suppose them to come from the same place, I think he overstates his case, and in support of this opinion I will draw attention again to that set of after-shocks which was most strongly felt at Kingston. Their average direction was from about 15° south of east, which is the direction in which buildings in Kingston fell, and the direction from which many facts indicate that the chief original shock came. Now, if the original cause be the same, and if, as in this case, the direction of approach be the same for original shock and after-shock, surely the logical burden lies on him who asserts that their places of origin are different.

I am glad that Mr. Oldham considers that the facts I have gathered form a useful basis for theoretical treatment; but I confess I am disappointed that he has given so little indication of the manner in which he would propose to deal with them. I think that, if you recall the history of scientific research, you will agree that a theory which groups together facts and explains them will hold the field, until another theory is put forward which explains more facts and explains them better. I think, therefore, that my treatment of the Jamaica earthquake will have to last, possibly to the detriment of science, until a better and more definite theory is advanced, which perhaps Mr. Oldham may achieve, but which he has not yet done.

Major CROSE: I am sure you will wish me to thank Dr. Vaughan Cornish for his very excellent and instructive paper. The facts he has brought forward will prove most valuable to all those interested in the subject.

IN SEARCH OF AN ARCTIC CONTINENT.*

By A. H. HARRISON.

IN starting on this expedition into the Arctic ocean, I hoped to achieve results which, however incomplete, might be of some slight service in adding to the knowledge already possessed of the North Polar Regions.

On July 4, 1905, I arrived at Edmonton, which is the most northerly post of the Canadian Pacific railway. After a few days' delay I went on to Athabasca Landing, where I had a skow—that is to say, a flat-bottomed boat—built. We started down the river on the 22nd with two years' provisions, some of which I had bought here and some at Edmonton. From Athabasca Landing to the Grand rapids—a distance of 165 miles—there is a very fine country, which is little known, and doubtless will one day be as thickly populated as any part of Canada. The rapids, which extend for the distance of 87 miles, are somewhat awkward to navigate; but, with the exception of the Grand rapid, no other part of the river offers any difficulty.

After leaving the rapids, a distance of 185 miles is travelled to Fort Chipewyan, after which the Slave river is reached; it wends its course for 312 miles into Great Slave lake. The navigation of the Slave river is very simple, with the exception of 15 miles of rapids, which have to be portaged over at Fort Smith. From Fort Resolution across Slave lake, Hay river is the first harbour, a distance of 70 miles. From Hay river to Fort Providence, which is the first post on the Mackenzie river, the only difficulty is getting into the river, the channel of which is crooked, and in many places shallow. From Fort Providence down to the Arctic Red river, lat. $67^{\circ} 26'$, long. $134^{\circ} 4'$, where I got frozen in, the distance is 900 miles, and the navigation is exceedingly simple for the whole distance.

The country that one passes through from Athabasca Landing down to the Arctic Red river is full of vegetation, and will, in my opinion, one day be settled. In all the mission gardens at the different posts that I passed, I saw wheat and barley growing, potatoes, lettuces, turnips, carrots, and every kind of vegetable that one grows in one's own garden at home. The country is thickly timbered near the banks of the river, and there are few places in which you do not find large patches of prairie. You pass by a great outrush of natural gas, and oil is oozing out for miles along the river bank. An Earth-movement has taken place, resulting in a line of fault, which is marked for more than 100 miles along the bank of the Athabasca river. Out of this, oil has been oozing we do not know for how long, and no one has yet found

* Map, p. 860. Read at the Royal Geographical Society, December 16, 1907.
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the reservoir of oil which may exist there. A German noble, the Count von Hammerstein, has spent a great deal of his own money and time in trying to find the reservoir, and I most sincerely hope that he may be successful. Coal and asphalt are to be seen everywhere, and there are great salt-plains not far distant. If three railways were run on to this great waterway (which could be done with a small outlay in comparison with the value of the country they would open up to the settler), the benefits reaped would be great. I should be an advocate for railways being built to Athabasca Landing from Edmonton, which would give easy access to 165 miles of river in one direction, and 210 miles in another up to Lesser Slave lake. A railway on to the Peace river would open up the whole of that waterway a distance of 600 miles down to the Slave river; while one railway from Prince Albert's to Fort McMurray would open up the Athabasca and the Slave rivers. The navigation on these waterways is effected with ease; any one can build a raft out of the timber which is at hand, place his cattle and farm implements upon it, and drift down the river until he finds the land he requires.

After traversing some 1800 miles of waterway, and taking observations for latitude and variation of compass at every point, I was frozen in at the Arctic Red river on October 4, and my position was that I had either to abandon all my supplies, or remain where I was until open water in 1906, which would mean wasting one year. I at once made up my mind to abandon the supplies and to go on with the dogs to Herschel island, a distance of 240 miles. This was not quite such an easy task as it appeared. After a great deal of difficulty and many journeys over to Fort McPherson, I at last succeeded in persuading two natives to accompany me to Herschel island with two sledges. One of the greatest difficulties that the traveller has in these parts is the economizing of supplies. Taking nothing with me but a Primus cooking-stove, instruments, and food, I could not reduce the weight of the sledges to less than 400 lbs. One sledge had 401 lbs. on it, and the other 405 lbs. There was a team of six dogs to each sledge.

We left Fort McPherson, on the Peel river, on February 14, and after travelling for ten days at an average of 24 miles a day, we got to Herschel island. Here I was in hopes of getting some supplies from the whalers, and making a sledge journey out on the ice, but, unfortunately, I found that they were all bound for San Francisco, and had been frozen in about a month earlier than usual, without any supplies for the present winter. I had abandoned my own supplies for no other reason than to make a trip out on the ice, and when I found it impossible to get anything at Herschel island either for myself or my dogs, I had to abandon the idea of going out on the ice. From what I gathered from the captains, I concluded that they had been out as far from land as any one could get with a properly equipped sledge expedition, on account of

open water, which I think exists off that coast, and I am still of the same opinion.

The position at Herschel island was briefly this: There were two hundred and fifty people on board five ice-bound ships, and of these only two vessels had any supplies at all. They divided up these stores, and, by keeping every one upon half-rations, there was only just enough food to last them until the middle of July. At the time of my arrival—February 24—the Eskimo were killing cariboo in the mountains within a few days' distance of Herschel island, where the deer-meat was most valuable to every one, but to bring it down from the mountains was a matter of great difficulty owing to the scarcity of dogs. Accordingly, I resolved to go into the mountains myself, and to lend my dogs to the whalers to get their deer-meat. I wanted to meet the Eskimo and to learn something about their language, in order that I might make use of them next year.

At the end of April I returned again to the ships, and made a map of Herschel island, which I did by triangulation, measuring my base out on the ice, and extending it over the island. This occupied me until we sailed.

On the 29th, while in the mountains, I saw the first fly—a blue-bottle. On May 31 we got our first geese, and on June 4 the first fish were caught at Herschel island. During this time I carefully noted all such days as were marked by the flight of wildfowl; and for two days early in June saw swan flying north-east true, great numbers of them passing Herschel island at a great height, and all going in the same direction. These were the only birds I saw not flying along the coast.

On June 16 I left the ships again to go over to the south-west sandspit, taking with me an Eskimo called Kokatu and his family. In crossing the bay, we passed over several lanes, which were about 12 feet wide in the narrowest place. On Monday, June 18, there was no sign of open water anywhere, and on Wednesday the 20th it was all open water. On July 1 the ice was full of holes, which rendered travelling quite impossible. I went back to the ships on July 3, going over the island, and on July 10 we put to sea. There was nothing but floe-ice in sight, with several lanes, and, after a great many difficulties and delays, we got to Point Sabine, and there took on driftwood to burn, as the ships had but little coal. We loaded every available space with wood, which, mixed with a little coal, lasted till August 14.

On July 12 we left Point Sabine and steamed round Pullen island, being in the ice most of the time. Whenever we could not go forward, we tied up to a piece of ice. There were plenty of seals and wildfowl in the water; and off the north side of Pullen island we encountered a great deal of old ice, which was drifting to the west. One of the ships tried to anchor, and lost its anchor; another ship injured its propeller. After leaving Pullen island we did not encounter much ice, but steamed

about 10 miles off shore to Cape Brown, afterwards crossing Liverpool bay to the Baillie islands off Cape Bathurst. While here I made a map of these islands, and got observations for latitude, longitude, and variation of the compass. Here we had a few days' delay, on account of a great mass of old ice which lay to the north-east of this point. I went out on this ice from the north end of Baillie island; it was quite stationary, and there were many pieces that I thought were 20 feet high.

On July 27 we tried to get round the Baillie islands. We steamed all day in a north-westerly direction, in heavy old ice all the time, and at six o'clock we tied up to a piece of ice. We were 20 miles off shore, and in 14 fathoms of water, and the ice was drifting to the west. As we were unable to make any headway, and as more ice was coming down from the north, we were driven back to the Baillie islands, where we had to take refuge on the east side of the sandspit.

We started again on August 3, and, after struggling with the old ice most of the day, steamed out into open water, and went straight across to Nelson's head, Banks Land. We got within a mile of Nelson's head, and steamed up the west shore of Banks Land, without seeing a piece of ice anywhere, as far as Cape Kellett. This was on August 5 and 6. On Cape Kellett there were a few pieces of old ice aground, and though I could see with my glasses the pebbles and stones on the beach, I could not descry a vestige of driftwood anywhere on this west shore. It was blowing hard on the 5th and 6th, so we did not anchor. I could not say whether there was a current along this shore or not, but, seeing no driftwood, I concluded that there must be a current from the north or south. If there *were* such a current from the north, and an ice-bound ocean to the north, it must needs bring down ice along the Canadian shore throughout the year; but during the time of open water that I spent on that coast, it was seldom that I saw any drift-ice. After we got away from the ice on August 4, there was really none to speak of within 50 miles north of the Canadian coast; this date agrees well with the date of open water round Point Barrow and Cape Kellett. There seem to be three points where the ice accumulates, and they are all clear about the first week in August. There was one year when the whale ships were unable to get to Banks Land, and this year north-west winds prevailed, and ice of this description extended everywhere from Cape Bathurst to Banks Land 10 miles off shore. A north-east wind prevailed whilst I was cruising in these waters, and on returning to Herschel island, I heard that they had had nothing but north-west winds.

On July 29 Captain Cottle was 50 miles north true of Herschel island. Current was running north-west true, and there were large flocs in sight; and it was reported to me that in September Captain Levett was 100 miles north of Herschel island, and killed a whale, with no ice in sight. After leaving Cape Kellett we steamed out north-west

true, seeing no ice, and came round eventually, after about three days, to Liverpool bay. There was a little ice still off the Baillie islands, about the same amount as there was off Cape Kellett. Between here and Herschel island, we steamed out some 50 miles from shore, and only saw a few flocs of old ice, which was at that time drifting west. We had had continual north-easterly winds.

On August 14, 1906, we got back to Herschel island. Here we had expected to find a tender bringing up coal and supplies for the ships to go out with, and I had arranged to get two years' supplies, which would have enabled me to complete the work which I came out to do; but, unfortunately, we received instead the news of the destruction of San Francisco by fires and earthquakes. To the whale-fishers, who all had their homes in San Francisco, and who had just gone through a winter of exceptional hardship, the blow was a hard one, and, after waiting for a week, they gave up all hopes of the tender, and started west on August 21. They offered to take me to San Francisco, nor have I ever received greater consideration from any one than was shown me by these brave fellows during my stay with them. I might also add that, though they have taken a great wealth of whalebone out of these waters, they earn every pound they make. As soon as I went ashore at Herschel island, I engaged two Eskimo and their families for one year to hunt for me and clothe me and keep me. They had a whale-boat each, and I had bought one from the whale-fishers.

On August 29 we left Herschel island; I intended to winter wherever game could be found, and wait in the Arctic for another year or two, if necessary. With this intention, I arranged with a whaling captain to bring me up two years' supplies. I went up the west branch of the Mackenzie river to Fort McPherson with three whale-boats, making a route survey of the river and taking observations for latitude, longitude, and variation of compass whenever possible; here I got some ammunition and rifles which I had left there the year before. I also obtained some supplies from Messrs. Nagle and Hislop, and started down the east branch of the Mackenzie for the Eskimo lakes, where I intended to winter. We got frozen in at the north-east end of what I call the Long lake, and here we left our whale-boats. We were now a party of thirteen, with eighteen dogs. We were in hopes of finding both deer and fish, but we found very few of either until late in November. We had to struggle for existence until October 20, when I decided to push on to the east. We travelled over a height of land, through a valley, for a distance of 27 miles, and came to the first Eskimo lake. After crossing the lake, we found, at the north-west end of it, a little river where there was open water and abundance of fish. We took as many as seventy white fish out of our net every time we went to it. The natives also caught from fifteen to twenty trout every day, and by setting night lines some losche were caught every

night. Finding no deer in the country, I thought this was too good a thing to pass, and so I decided to winter here. I had surveyed the country as far as this, getting observations for latitude, longitude, and variation of compass everywhere along the route, but now I hoped to get a few occultations. We were now near the edge of the timber-line, but there was plenty of wood to build a house and to make fires, so I told the natives to build two houses—one for myself, and one for them. I stayed here until January 19, when I went down to the coast, returning by another route, and reaching camp the second week in February. During this journey we had four cold spells, the thermometer once registering from 50° to 57° below zero for a week. I surveyed the route I took and the route I returned by; the country between my winter camp and the coast is a mass of small lakes and hills, which are often conspicuous for the volcanic appearance they have, but they are not of volcanic origin.

The Eskimo told me we should get no fish after the sun had returned. Even when I left camp fish were not numerous, but when I came back they could not be caught by hook or by crook, nets and hooks being both useless. My scanty supplies having all gone, we had a very hard struggle for existence, and for six weeks we lived on ptarmigan, which the natives snared with twine or shot on the neighbouring hills, and on musk-rats, which were caught on the lakes under the snow in small traps. Needless to say, our fare was a very scanty one, but we managed to keep most of our dogs and ourselves alive until March 25, when we started off in an easterly direction down the great waterway (which I particularly wanted to survey) into Liverpool bay. I took with me two natives, the women and children, and the dogs, which now numbered only twelve, as I had lost some during these hard times from starvation.

I followed and surveyed this great waterway by stations of triangulation, route surveys with a prismatic compass, and observations for latitude, longitude, and variation of compass whenever possible until I got in sight of Liverpool bay, and here, through shortness of food, we had to go to the coast. The country between the Eskimo lakes and the coast is particularly flat, dotted with conspicuous hills rising straight up out of the ground. According to Sir J. Richardson, they are of gravel and mud formation, but the abrupt angle they form with the plain is particularly interesting if this is correct. After five days of starvation, which forced us to kill two dogs to keep the rest alive, we arrived at Kangianik, where an old Eskimo called Tiukpuna treated us with great hospitality. I surveyed this coast-line carefully with a prismatic compass, getting observations whenever possible, and found the sandspits and points to be of a curious length and shape; this is a feature of the whole coast-line. During this time I never heard the natives complain, and they always appeared as cheerful as if they had

plenty to eat. On May 3 we went to the east branch of the Mackenzie river, travelling up it knee-deep through soft snow and slush; nor were we able to put our sledge ashore, by reason of the open water on either side of the river, but had to camp every night on the middle of the ice. However, we managed to get to our whale-boats before the ice on the river broke up, when we again suffered considerable privations on account of the scarcity of food. On May 14 we got our first wildfowl, and after this we enjoyed plenty, such as it was, until I returned to Fort McIlherson in June, where I waited for my mail which brought me home. Coming down the Mackenzie river, when in sight of Point Separation, the high ground on the east side does not follow the present course of the river, though the bank is 40 feet high, and thickly timbered; but the hills are some way to the east, and run in a straight line to the south end of the Long lake, and from here they can be traced to Liverpool bay, on the south-east side of the Eskimo lakes.

Where this little river, which we went up in our whale-boats to get to the Long lake, enters the Mackenzie river there is high ground, which you can also follow to Liverpool bay in one direction, and to Richard island in another. From here to Richard island the Mackenzie flows close under the height of land, and in some places the banks are precipitous. The country between the Eskimo lakes and the coast slopes down more gradually from the Mackenzie river into a very flat coast-line, extending 10 miles from the ocean, and is dotted all over with conspicuous hills. They rise out of the flat ground from 100 to 200 feet, and the top forms a round basin 5 to 10 feet deep in the centre. The natives value those near the coast as certain reservoirs of water. In the mountains on the west side of the Mackenzie to the south and east the slopes appear precipitous, and to the north and west more gradual.

The Mackenzie river begins to widen out into a delta at Point Separation, which is 200 miles by water from the most northerly island, and in its widest place is 45 miles broad. The west branch of the river breaks up into many channels, which have cut their way through a plain lying immediately under the mountains. West of this plain you come to Shingle point, and this forms a bay with the sand-bars, which extend in a westerly direction from Tent island.

The main channel of this river wends its way through many islands along the coast between Hooper and Pullen islands. The east branch comes into the ocean by many channels, lying between the north-east corner of Richard island and Toker point; that between the mainland and Richard island is narrow up to Point Encounter. From here it widens, but there are many sandbars in the bay formed by the north-east end of Richard island and Toker point. From the north-east end of Herschel island there is a bank which extends in an easterly direction, and is called the "ridge:" it is over this ridge that there is always a large tidal crack in the ice every year.

Much of the driftwood that comes out of the Mackenzie is caught by these islands and sandbars, but some of it is carried out to sea. For example, after leaving Point Sabine I saw driftwood, on July 12, floating in the ocean 9 miles off shore; off Pullen island, 10 miles to the north, I saw more of it; on July 16 and on July 18, off Toker point, some 10 miles from shore, we passed a quantity of driftwood. The shores of the Arctic ocean from Cape Parry to Herschel island are strewn with this strong timber, which comes down the Mackenzie, the Clarence, the Anderson, and the Horton rivers; there are only two places between these points where wood is not found, and the reason is that the shores are precipitous. These rivers are building up islands on what were submerged banks, and the ocean is receding. In all these islands I found ancient driftwood in the high banks. While making a map of Herschel island, I found in many of the gullies pieces of similar wood, sticking out of the mud in the bank, in most cases 50 feet below the present surface of the islands. The whaling captains who blasted out the ice-houses at Herschel island told me they found quantities of this same wood. The ice-houses are 20 feet below the surface, and go down to sea-level. The wood I saw off Sabine point was drifting to the west, and that off Pullen island and Toker point to the east. What wood I saw is a very small portion of that which is carried out to sea, and it is difficult to understand why a great deal of this *débris* is not drifting on to the western shores of Banks Land. The absence of driftwood upon the western shore of Banks Land would seem to indicate a current that is perhaps being diverted on to that land by other land to the north and west.

In the preceding pages I have told the story of my journey. Although circumstances prevented me from actually going out on to the ice to investigate the Arctic mysteries, I saw enough during my stay of eighteen months on the shores of the Arctic ocean to somewhat justify the conclusion that our data at present are quite insufficient to establish the existence of a vast polar sea. It is true that most competent authorities hold that no extensive land can be found in the unknown region; with this conclusion we may agree from want of further knowledge, but when we came to examine the reasons they advance, to say the least of it, they are not convincing. The real conclusion to be drawn from what is known seems to be that the existence or non-existence of land is as much an open question as ever. Apart from the fact that authorities of the greatest weight draw diametrically opposite conclusions from the same data, does it not seem somewhat premature to describe the geographical condition of an unexplored region from a mere study of its boundaries? Let us take an example. Suppose we did not know of the existence of Australia, who, I ask, from a study of the geographical conditions which obtain between the 5th and 10th degrees of S. lat., could ever have deduced the existence of a great

continent like Australia? Is it not, from first principles, both dangerous and scarcely in accordance with strict scientific methods of reasoning to deduce the existence of any physical fact which has never been put to the test of experience?

I have at the present moment before me a map by Dr. Nansen, showing a deep basin in the unknown area; a map by R. A. Harris, showing a continental mass of land; a map by Commander Peary, showing a land to the north-west of Grant Land, which he has never visited, but has named "Crocker Land." The whole inference is from known facts. How can we be at all sure that we know all the facts?

The Soundings found by the "Fram."—If we consider the known facts, the soundings found by the *Fram* might be taken to denote land at the pole. For example, from where the *Fram* got frozen in to where she got free roughly represents 1000 miles. We know something of what exists south of this line; to the north we know nothing. Now, let us measure 1000 miles in the same drift, along the meridian, from 80° to 63° N. lat. Throughout this distance we know that land exists on both sides of us, east and west, that the deep channel is narrow, and that the soundings are even deeper in places than any found by the *Fram*.

Let us suppose we did not know of the existence of Greenland, and let us suppose some one were to go out on the ice in a westerly direction from the Spitsbergen archipelago, and came back with the soundings of 2600 fathoms, found 175 miles west of Spitsbergen. Could we infer that if he had continued his course for another 200 miles he would have found Greenland?

The Drift of the Ocean.—Nothing that has been put down or got adrift east of Point Barrow has ever been heard of again. Many ships have been wrecked. For example, four vessels were wrecked east of Point Barrow while I was on that coast; nine drift casks were set adrift east of Point Barrow in 1899 and 1900; again, whale ships have been passing every year east of Herschel island since 1889, and there was no part of the Arctic coast that I visited where I did not find among the driftwood derelict belongings bearing the name of these ships. In the case of wrecked vessels, they may have been smashed by the ice and sunk, but there are many things on a ship which cannot sink, and which have the ship's name upon them. Now, I ask, how does it happen that none of the immense quantity of *débris* which, in accordance with the above facts, has been set adrift, has never yet found its way, as far as our present knowledge goes, across the Arctic ocean?

We know that a drift cask did drift from Bering strait to Iceland. In considering the known drift of the ocean, we cannot take the drift of the *Jeannette* and the *Fram* jointly, but the drift of the *Jeannette* and her relics give us fairly safe data from which to estimate the course taken by the buoy.

We may take it for granted, from what we know of the drift of the

Jeannette and her relics, that the speed of the buoy can hardly have been less than 2 miles per day of twenty-four hours. This rate receives further confirmation from the able arguments of Dr. Nansen, respecting the drift of these same relics.* But if the buoy took the shortest possible route across the pole, it scarcely attained a speed of 1·2 miles per day of twenty-four hours. Therefore we may assume that the buoy did not go by the shortest route. But we may go further, it must have gone a longer route than the known route of the *Jeannette* and the *Fram*, for the latter would only give us an average rate of 1·5 mile per day. Therefore, may we not conclude, on the 2 miles a day hypothesis, that the buoy travelled by a longer route even than the *Jeannette* and the *Fram*?

The Ice.—If we assume that this buoy drifted across the Arctic ocean north of the *Fram*'s route, as Dr. Nansen suggests,† it is difficult to suppose an extensive land or any mass of palæocrystic ice in the unknown area. This I estimate, taking out all known ice journeys, to be 1,251,874 square miles in extent, and the Arctic ocean has an estimated area of between 4 and 5 million square miles.‡ Now, what is the significance of the six years' drift of this buoy? Does it mean that the polar sea clears itself of ice every six years? If this is the case, what becomes of all this ice? Assuming that the total breadth of the channels leading out of this enclosed sea is 1000 miles, and that the average rate of the current flowing through them is 2 miles a day of twenty-four hours, it would take ten years at least for the 4 million square miles of ice to pass through, even on the assumption that the flow continued for two hundred days every year.

Some slight corroboration of the above argument may be found in Commander Peary's experiences.§ The drift shown by these ice journeys north of Greenland and Grant Land running west to east, does not indicate a current passing over or near the pole and coming from Bering strait, but rather a current running in exactly the opposite direction to the current in which the *Fram* drifted.

In conclusion, I may repeat what I said at the beginning, that the existence of land at the pole is by no means yet disproved. Without attaching too much weight to the arguments I have advanced, they do at least suggest some difficulties in the way of the deep-sea basin theory. There is yet some room for searchers of Arctic continents, and nothing would please me better than to have the means and opportunity of once more trying to solve this great Arctic mystery.

* Dr. Nansen's 'Furthest North,' vol. 1, p. 20.

† *Geographical Journal*, December, 1907, "North Polar Problems."

‡ *The Bulletin of the Geographical Society of Philadelphia*, January, 1906, vol. 4 p. 3.

§ Commander Peary's map, 'Nearest the Pole.'

Before the paper, the **PRESIDENT**: I have to introduce to you the lecturer of the evening, Mr. Harrison, who has furnished one more instance of the advantages geography has drawn from love of sport. During the last twenty years, or nearly so, Mr. Harrison has been on various shooting expeditions, two of which were into the Rocky mountains, and he passed the winter of 1902-03 in the region of Great Slave lake. On his return home, Mr. Harrison determined to go through a course of surveying, in order to make his future travels more valuable from a geographical point of view. Accordingly, he went through a course under Mr. Reeves of our Society, and, thus scientifically equipped, he started on the journey which he is going to describe to us to-night, and which, I wish to remind you, was done entirely at his own expense. During that journey he has made a very large number of observations for variation of the compass, for latitude and for longitude, with occultations on five or six occasions, and he worked out the results on the spot, some of these observations with the thermometer 50° below zero. I will now invite him to read his paper.

After the paper, the **PRESIDENT**: I fear that we shall not have a discussion on the interesting points which Mr. Harrison has raised in the last part of his paper, because, so far as I know, there are not present to-night any Arctic experts who are willing to speak. We had hoped to have been honoured by the presence of Dr. Nansen; but he is suffering from a domestic bereavement, in which I am sure this Society will deeply sympathize. But I think that Mr. Harrison's paper can stand very well without discussion. It has been to me, and I am sure to you, extremely interesting, and we tender him our sincere thanks.

THE GORGE AND BASIN OF THE ZAMBEZI BELOW THE VICTORIA FALLS, RHODESIA.*

By G. W. LAMPLUGH, F.R.S., F.G.S.

The upper of the two cataracts is far less impressive, being merely a broad transverse band of comparatively shallow rapids, separated by protruding rocks. Between it and the lower cataract there is a wide basin of comparatively still water with slow eddies, and above it also the river has a slack current, and is bordered on the left by an extensive and exceptionally level flood-platform of rock. Mr. Sykes was informed that at this place "Batoka refugees were in the habit of crossing to the right side of the river in canoes, and thence making their way on foot to the small rocky island below the fall [seen in Fig. 9], which they used as a hiding-place from their enemies."†

Eastward from the Chimamba the country bordering the gorge on the north is so severely dissected that its plateau-character is almost lost; and, with the broadening of the valleys and the breaking down of

* Continued from p. 152.

† There are many stretches of the river in the gorge where a strong well-manned canoe, if skilfully handled, might, I think, be navigated; and the flood-platform might afford a rough but practicable portage where the rapids are too formidable. But the risk would be great, and the presence of crocodile in all parts of the gorge that we visited is discouraging to adventure of this kind.

the intervening tabular ridges, there arises a conspicuous development of characteristic trap- or step-like features in the landscape, from the unequal weathering back of the successive outcrops of massive basalt and scoriaceous rock. Mr. Sykes's description of this country is as follows :—

“From the Chimamba onward for many miles the gorge is practically unapproachable, the neighbouring country being worse than anything yet experienced. That no one up to this time, except

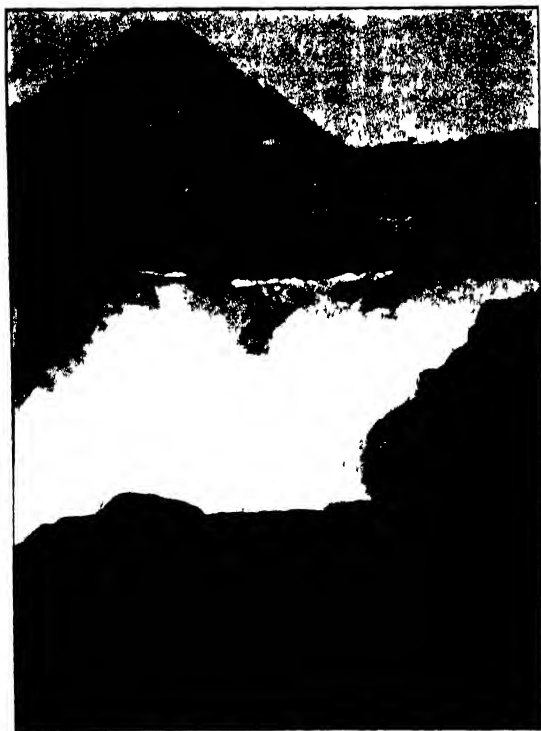


FIG. 10.—THE LOWER CATABACT AT CHIMAMBA.

(Photo by P. W. Sykes)

hunted fugitives, had attempted to penetrate into this very wilderness of rock and ravine is not surprising. After skirting round the head of this disrupted region, Koluja gorge is reached. This extends for about 3 miles in a north-westerly direction from the Zambezi. It is an immense cleft, being approximately 500 feet deep and about 250 yards across from surface to surface. . . . I attempted to follow the Chibongo [another northerly tributary] to its confluence with the main stream, but to no purpose. Its bed, between walls and steep hills, consisted of smoothly polished rocks, over which safe progress can only be made with

the utmost caution. After negotiating about $2\frac{1}{2}$ miles of this steeply shelving creek, all further advance was effectually checked by a series of almost perpendicular falls. During the rainy season this stream must be a succession of falls and cascades of more than ordinary beauty and variety.

"After another abortive attempt to reach the Zambezi, . . . I eventually succeeded in doing so by following the line of country between the Chibongo and the Kamadyango, making a *détour* over some difficult country by Suenani hill. Thence to the river was about 5 miles, and it was reached just at the spot where the Chibongo waters join the main stream. Immediately above are the Kwemani rapids, a very excellent view of them being obtained from this spot. The confluence of the Kamadyango is less than 2 miles down the river; and in between, a curiously shaped rock is met with, known to the natives as Kurusman. A somewhat similar one is also observable some distance down the gorge on the opposite side, which is called Sibarataan."

Again leaving the Zambezi at the Chumamba to avoid the roughest of this country, though still now always traversing irregular hilly ground in which the flat-topped ridges and kopjes were the only remnants of the original plateau, we made our next approach to the river some 15 miles farther eastward, by way of the tributary ravine of the Karamba stream, once more following the path of Mr. Sykes's previous exploration. This stream, in dropping from the plateau into a narrow cleft about 300 feet deep

which we named Kalonga's cleft), shows with peculiar clearness how the characteristic

angularities in the drainage system of the country are developed. I have sufficiently described the conditions in my previous paper,* from which the accompanying sketch-plan, bird's-eye view, and section are taken (Figs. 11, 12, and 13).

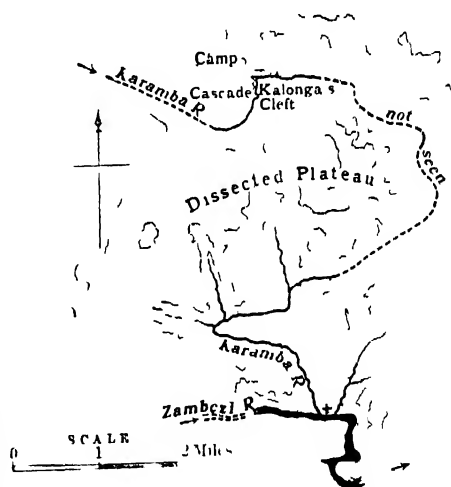


FIG 11 - SKETCH-PLAN OF THE KARAMBA RIVER, FROM ABOVE KALONGA'S CLEFT TO ITS CONFLUENCE
(+ = View point of Fig 15)

* *Quart Journ Geol Soc*, vol 63, pp 190-192

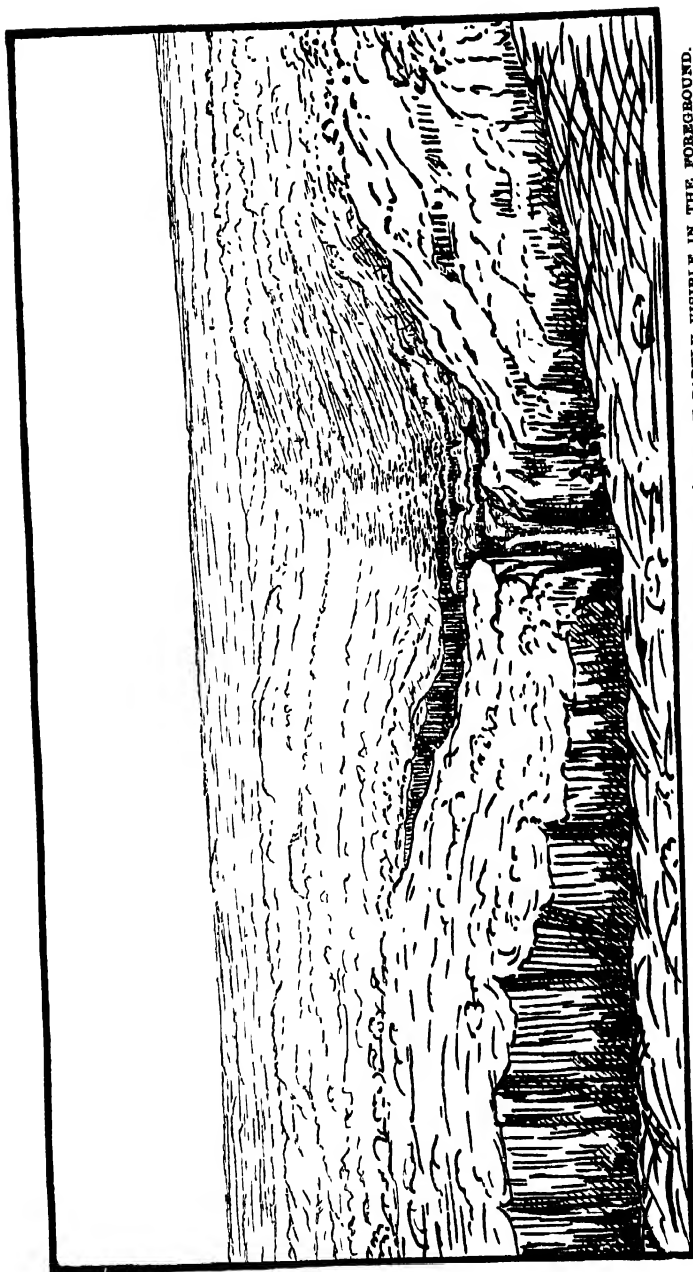


FIG. 12. —BIRD'S-EYE VIEW LOOKING UP THE KARAMBA VALLEY, WITH KALONGA'S CLEFT PARTLY VISIBLE IN THE FOREGROUND.
The dry-season stream is intercepted by a transverse gully (shown in section in the next figure), and is diverted to the left, but doubles back sharply and falls into the side of the ravine above Kalonga's Cleft.

It was with some difficulty that we found a practicable way of descent into the ravine of the Karamba.* But this accomplished, it was comparatively easy to scramble for 2 or 3 miles along the floor of its highly picturesque glen to its junction with the Zambezi (Fig. 14). There were signs, however, that the stream sometimes floods the bottom from side to side and rises many feet high against the confining walls; and in the rainy season these ravines, like the arroyos of the North American desert country, may be dangerous from the risk of sudden spates.

At the Karamba confluence the sides of the Batoka Gorge are weathered down into long slopes, as shown in Fig. 15, but the valley is not much wider, nor in general aspect more conspicuous, than some of the tributary ravines with which the bordering country is intersected. In fact, the view from a high ridge above the sharp bend of the main river east of confluence revealed a confused maze of gorges, among which that of the Zambezi was distinguishable only by its broad ribbon of water.

Since leaving the Mavangu we had traversed an uninhabited country, and as supplies for our carriers were running short, we were compelled to press on by the quickest and easiest route, so that we did not again reach the Zambezi from the northern side till we arrived at Makwa. During the greater part of this four days' march our native guides declared that the river was at a long day's journey or more to the south of us. But if they had any definite knowledge of its position, which is somewhat doubtful (as they not unnaturally hold the network of gorges in dread), their estimate must, I think, have implied the difficulty of the route rather than the actual distance. At any rate, I saw, from a commanding view-point near our camp at 'Ntoro, the edges of a deep continuous ravine in the midst of a desolate wilderness at a distance of not more than 4 or 5 miles, which, from its direction and from subsequent observations, I suspect to have been the Batoka gorge itself, near its termination. But one would have had to reach the very crest of its trench before one could be assured, by the gleam of its waters, that the elusive river did indeed hold this course.



FIG. 18.—PROFILE OF THE KARAMBA RIVER-BED AT THE WATERFALL ABOVE KALONGA'S CLEFT.

* Some alpine cord with which I was provided was occasionally of service in these descents, especially for preliminary exploration.



FIG. 14. LOOKING UP THE KARAMBA VALLEY FROM ITS MOUTH DRIFTED SAND FROM THE ZAMBEZI SHORE IN THE FOREGROUND

(Photo by F. W. Sykes)

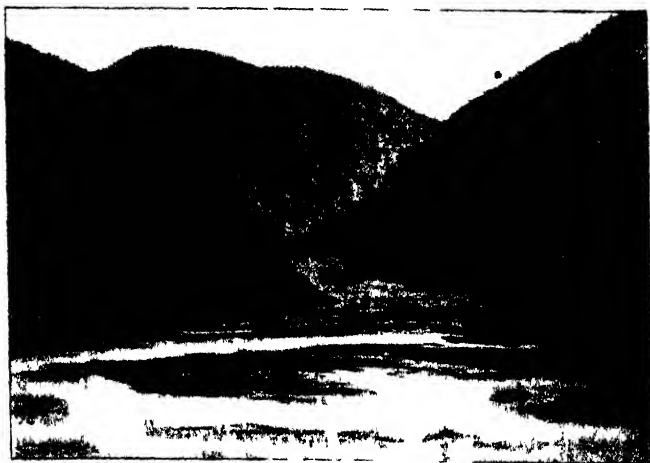


FIG. 15.—THE BATOKA GORGE, LOOKING DOWNSTREAM FROM THE CONFLUENCE OF THE KARAMBA.

(Photo by F. W. Sykes)

From the northern side, therefore, the most easterly spot where we actually explored the gorge was at the confluence of the Karamba; but I afterwards reached it from the south at a place approximately 15 miles east of the Karamba. This was after we had ferried across the river at Makwa, and I had started afresh under the guidance of the late H. F. Greer to traverse a route over the plateau to Matetsi station. On the third day of this westward journey we diverged sharply north-eastward from the Lukunguli valley, and continued on this course until we neared the Batoka gorge. Our track lay across comparatively even country which sloped gently toward the Lukunguli until we were within 5 or 6 miles of the Zambezi, when we crossed a low rocky watershed and entered a much rougher stretch which drained directly northward. This direct drainage has probably been initiated by the excavation of the gorge, and is now eating backward into the older basin of the Lukunguli, which trends eastward, approximately parallel to that of the Zambezi. At the head of the new drainage, shallow rocky cirques have been developed, and lead downward into narrow chasms that fall abruptly to the main gorge. From the crest of one of these cirques to the bottom of the great cañon, according to my aneroid, the fall is about 836 feet.

We made a fatiguing but not difficult descent into the gorge over tumbled blocks and rainwash, down a crumbling spur overgrown with the usual dry bush. When we reached the bottom, our view was rounded off at a short distance both ways by the curves of the cañon, and the broad strand on which we stood seemed like a quiet island in the underworld. It was here that we saw on the strand the previously mentioned spoor of lion, along with that of several "buck;" and a huge crocodile floated basking in a smooth eddy. The river ran swiftly but noiselessly in a deep stream that at its narrowest was 90 yards wide. There are rapids not far distant, however, for at night the clamour of broken water from a lower reach could be heard at our camp on the crest of the gorge.

The persistence of the trench-like character of the valley down to this point, and its absence at not many miles farther down-stream, seem to imply that the sharp break between the low-level and high-level parts of the river, which now causes the Victoria Falls, was first developed in the portion of its course which lay above the confluence of the Matetsi.

Near the mouth of the Matetsi the main river, in its dry-season condition, forms a broad stream with deep pools, much frequented by the hippopotamus, and with many shallows interrupted by islets. Below the Matetsi confluence it is at first confined in a narrower, yet comparatively shallow, valley. Then it again expands, and at Makwa its aspect recalls the river scenery above the Victoria Falls—a tranquil stream about half a mile wide, flowing among well-wooded islands, in an open valley with irregular slopes, from which kopjes of no great

height here and there make salient projections (Figs. 16 and 17). This is the character of the river and its valley to a little below the confluence of the Deka; and then the hills close in upon it again and involve it in the wild lower gorge described with such depth of feeling by Major A. St. H. Gibbons.



FIG 16—THE ZAMBEZI VALLEY NEAR MAKWA (WANKIE'S DRIFT), LOOKING DOWNSTREAM FROM THE SOUTH SLOPE ABOUT A MILE ABOVE THE DRIFT.

(Photo by Colonel F W Rhodes)

Relation of the Tributaries to the Trunk Drainage. Northern Tributaries.—

On the northern side of the Zambezi, throughout the Batoka plateau, the subsidiary stream-system radiates outward from the highland of ancient igneous and metamorphic rocks that bounds the basaltic plain on the north-east, and this system is probably therefore of the "consequent" type. From the highland the streams flow north as tributaries to the Kafue river, and west, south-west, south, south-east, and finally east, as direct tributaries to the Zambezi. In the portion of this direct system crossed by our traverse, the average course of the tributaries swung round from south-west in the neighbourhood of Victoria Falls to south-south-east in the neighbourhood of Makwa. The streams in our path that appeared to belong to this consequent drainage were the Maramba (which has its confluence above the Victoria Falls, and, not having yet been rejuvenated, is graded down maturely to the main river), the Ungwesi or Kalomo (the latter name being preferable because of the confusion with another Ungwesi or Ungwesi farther westward),

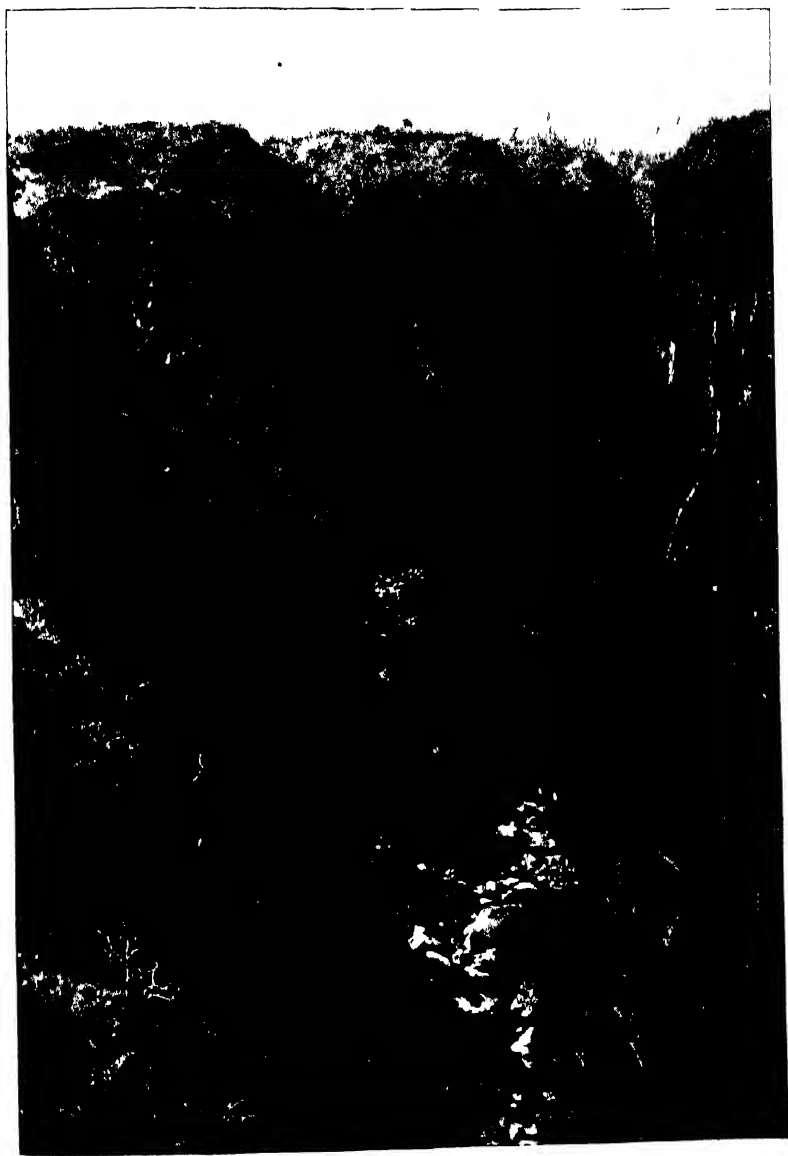


FIG 17. The Ravine of a northern tributary, about 20 miles East of
Victoria Falls.
(Photo by F W Sylkes.)

the Namaruba, the Gwemansi, and perhaps the Bwani and the Chibongo (the last, not shown on my sketch-map, lying between the Mambo and the Karamba).

But besides these long-established tributaries, there are numerous smaller streams flowing directly into the gorge, that have probably been developed more recently, under conditions to which I have previously referred. In most cases these have begun as temporary rain-gullies on the flats in the immediate neighbourhood of the gorge soon after its excavation. By reason of their excessive gradient, and their picking out of the weakest vertical planes in the rock, these gullies have been extended backward rapidly into the plateau, and have soon developed small independent basins, which have broken into the territories of the older tributaries, sometimes even capturing and diverting them. The indications of these minor revolutions, in the form of truncated segments of older valleys, are numerous in all the dissected portions of the plateau, and are occasionally associated with a sprinkling of pebbles, representing ancient stream-detritus.

Many of the new streams still lie wholly within the rocky country along the rim of the gorge, but the sources of others reach back to the sand-bults that bound the rugged tracts on both sides of the Zambezi. The short newer streams all cease to run during the dry season; and even among the tributaries considered to belong to the original group, it is doubtful whether any within our traverse, except the Kalomo, maintains a perennial flow.

The natives have names for most of these watercourses; and among those west of the Karamba, noted by Mr. Sykes, but not shown on my sketch-map, are the Namburu, Chisoni, Kengana, Musaki, Mara, Kasya, Mabombo, and Chikamba.

I have already described the ravine of the Songwi, which may be taken as a type of the habit of all these streams in their approach to the main gorge. The bird's-eye view of a segment of the Karamba valley, given in Fig. 12, p. 290, exemplifies their behaviour in descending from the plateau. The aspect of these ravines where they have been somewhat widened by weathering is as shown in Fig. 17.

Until we reached the Kalomo river we were able to cross all the northern tributaries above the place of their sharp descent. But this stream, by far the most important northern feeder that lay in our route, has carved out for itself a profound valley enmeshed by the ravines of its branches, the whole forming a complex basin of excessively rugged character, sinking deeply into the plateau. It happened, unfortunately, that my aneroid was rendered temporarily useless by an accident just before we descended into this wild basin, so that I was deprived of its aid in estimating the relative level of the stream at our camp in the bottom of the valley, but it was my impression that the Kalomo at our crossing-place had graded down its bed approximately to the new or

low-level position of the Zambezi, and that there was unlikely to be any considerable further fall between this place and its mouth. I regretted that circumstances did not permit me to follow this river both downward and upward, as its exploration would probably have yielded results of much interest both physiographically and geologically. The huge flood-bars of rolled stones in its bed contained evidence of wide diversity in the rock-structure of its upper reaches, and also showed how powerful its torrent must be when in spate. At the time of our visit (middle of July) the stream still maintained a flow greater than that of any other tributary of the Zambezi within the area of my traverses. We were just able to cross dryshod by selecting the biggest natural stepping-stones.

We mounted steeply out of the Kalomo basin on its eastward side by the coombe-like valley of the Knongu, one of its many branches, and after traversing a complicated stretch of broken ground, due to the influence of the low-level Kalomo drainage, we again reached the comparatively level plateau. Our next three streams, the Namaruba, Gwemansi, and Iburumansi, were all crossed where they ran feebly in relatively shallow valleys of the plateau-type.

The Kalomo (Ungwesi) is the only tributary shown in this part of the country on the B.S.A. Co.'s map; but the three streams above mentioned are evidently those indicated farther northward on the map in Major A. St. H. Gibbons' 'Africa from South to North' (vol. 1), as having been crossed in the route followed by Captain G. Hamilton and Major F. J. Quick in 1899. The "Maroba" river of this map is doubtless that for which we obtained the name "Namaruba"; the other two, and also the Bwani further eastward, are shown without names.

From some glimpses of the distant country to the northward that I obtained in this district, and from geological indications, I suspect that the heads of the basins of the Namaruba and Gwemansi have been encroached upon by aggressive eastern feeders of the low-level Kalomo river.

Southern Tributaries.—There is a remarkable difference between the subsidiary drainage-system of the basalt country to the south of the Batoka gorge and that to the north of it, for the courses of the northern streams in the district examined make a wide angle with the main river, whereas the chief southern tributaries within the same longitudes trend towards the Zambezi at an acute angle. Indeed, some portions of the courses of these latter tributaries or of their feeders follow a direction approximately parallel to that of the main river. Moreover, the deeply sunk basins of the chief southern tributaries are much more expanded than those of the northern streams (with perhaps an exception in the case of the Kalomo), or even, as it seemed to me, than that of the Zambezi itself in the same longitudes. Thus, the Batoka gorge, wherever I saw it, forms in cross-section a simple though deep notch in the plateau, with mere traces of a shallow outer valley occasionally

associated with it; while the basins of the Deka and Matetsi form broad depressions, in which there has been a general lowering of the plateau over a wide extent of country, associated with inner ravines of relatively small dimensions. Indeed, the basin of the Matetsi appeared to me to be the chief factor in the physiographical shaping of the country south of the Batoka gorge, its northern rim parallel to the Zambezi having gained so far northward that the direct drainage to the main river is confined within very narrow limits.

Our knowledge of the region is perhaps still too scanty to warrant the interpretation of its structure, but we may, at any rate, recall one obvious reason for the conditions above mentioned. Both the Matetsi and the Deka join the Zambezi below the end of its gorge, and their low-level outlets are therefore of high antiquity; so that during the whole time that the main river has been carving out its cañon, these tributaries have been lengthening and widening their nearly parallel basins in the plateau, thereby drawing more and more of the upland drainage within the sphere of their influence, and perhaps even robbing the Zambezi itself of some of its sluggish unrejuvenated feeders.

But now the conditions are again altered; the gorge has reached backward beyond the basin of the Matetsi; the short direct streams of precipitous gradient, vigorously at work, are beginning to encroach upon the inward slopes of the aggressor, and the factors that tell in the competition are reversed. The Masui river, especially, that joins the Zambezi from the south 3 or 4 miles below the Victoria Falls, though as yet it has had time to develop the full effect of its rejuvenation only for a very short distance above its mouth, has a promising future, boding mischief to the western flank of the Matetsi system. But at all times, whichever system gains, the plateau always loses.

Consequent upon the obliquity in direction and relative maturity of these southern tributaries, it happens that a profile-section drawn southward at a right angle from the middle portion of the Batoka gorge to the margin of the Kalahari desert will intersect at least three wide depressions—the first containing the Lukunguli, an important feeder of the Matetsi; the second, containing the Matetsi itself; and the third, containing the Deka river.

It is noteworthy that this subparallel stream-system appears to be restricted to the basaltic country, and to that portion of it which has been longest under dissection. On the east it is not maintained by the Gwai, which flows approximately northward from an upland of older rocks; and on the west it ceases with the Masui, which also appears to hold a general northerly course, though swerving eastward for a few miles above its confluence. Probably the prevalence of east-and-west planes of weakness in the basalts, to which I have previously referred,* has

* For fuller discussion and illustration of the effect of these planes on the drainage see my previous paper, *Quart. Journ. Geol. Soc.*, vol. 63, pp. 187-192.

been the predominant factor in this matter, its effect becoming progressively greater in proportion to the antiquity of the low-level drainage. If this be so, the streams in question in their present form are "subsequents," and may depart widely from earlier conditions.

Though the cartography of the region south of the Batoka gorge is well in advance of that of the northern side, it is yet very imperfect, and, except along the route of the new railway, still depends mainly upon the maps of those great pioneers, James Chapman and Thomas Baines, published nearly fifty years ago.* Their mapping of the Matetsi† basin shows much detail, and has not been improved by the interpretation of it given in recent maps (*e.g.* The B.S.A. Co.'s "Rhodesia," on the 1:1,000,000 scale, sheet 5).‡ The lower portion of the Matetsi is named the "Mapako river" on Chapman's map, and the "Makapo" on that of Baines, but neither name appears now to be known to the natives. In endeavouring to revise their results I was fortunate in having the assistance of the late Mr. Greer, whose knowledge of the native tongue was essential to my object.

At Makwa (Wankie's drift) I was able to identify "Logier hill," the site of Baines' disastrous encampment during his attempt to build boats in which to navigate the Zambezi (see Fig. 18). We were guided to this place by two old natives who recollected the circumstances well, though they could only tell of two white men there—Jabomani (presumably Chapman) and Jantoni (Anthony, the young Boer)—and did not seem to remember a third.

The stream-bed west of this kopje, dry, at the time of our visit, shown as Logier river on Baines' map, is known to the natives as the Gongobujo. The view reproduced in Fig. 16 (p. 294) looks across the delta of this tributary. Our route followed up this stream-bed for 2 or 3 miles, and then crossed a broad high-lying sand-belt, from which we descended steeply into the valley of the Matetsi about 4 miles above its confluence, where it has a somewhat wide floor, not far above Zambezi-level, and is lined with alluvial terraces, cultivated by the natives. According to Mr. Greer, the name of the river, to be in keeping with the native pronunciation, should have been transliterated "Matezi" (which would also have served to distinguish it from the northern Matetsi, a feeder of the Kalomo river). But as the latter spelling has been adopted officially for the station and post-office where the railway crosses the river, it will now stand.

On our westward march from the mouth of the Matetsi we rose

* J. Chapman, 'Travels in the Interior of South Africa' (London: 1868); and T. Baines, 'Exploration in South-West Africa' (London: 1864).

† Spelt "Matetsie" by Chapman, and "Mateitsie" by Baines.

‡ Published by E. Stanford, London.

quickly for about 450 feet to a wide spur of the plateau, and then as rapidly descended into the broad deep valley of an important east-flowing feeder of the Matetsi, which we followed up for two days to its head. In the lower part of this valley, the river (which at the end of July still maintained a strong flow of water) is known to the natives as the Lukunguli; but the dry stream bed on the undulating plateau that we followed during the second day was called the Jambezi. I am a little uncertain, however, whether this watercourse constituted the main head of the Lukunguli, or whether it is one of the branches.

There can be little doubt that the Jambezi-Lukunguli is the stream

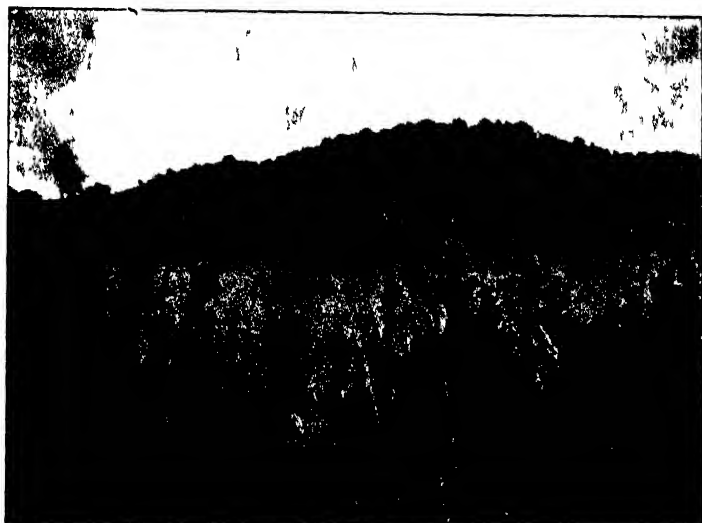


FIG. 18 — THE JAMBEZI RIVER AT MAKWA (WANKIE'S DRIFT), WITH LOGIER HILL IN THE BACKGROUND

(Photo by F. W. Sykes)

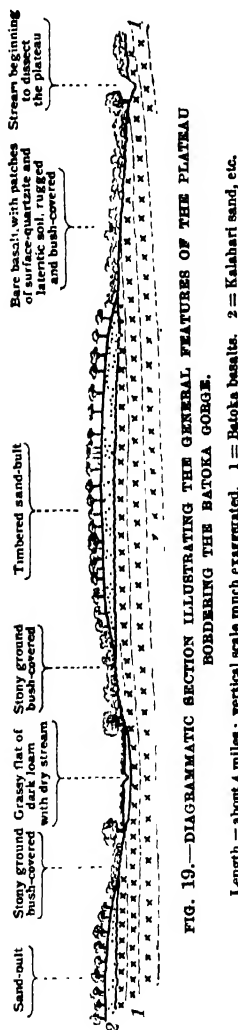
indicated on the maps of Chapman and Baines as the Myatambesi. Its continuance eastward was left somewhat uncertain on their maps; but it was supposed to flow independently to the Zambezi, and to have its confluence a little to the northward of that of the Matetsi. From a view-point at the mouth of the Matetsi I saw a side-valley in approximately the position of the supposed confluence of the Myatambesi, but this must belong to a stream of the short direct type, and not to the Lukunguli, for the latter river joins the Matetsi 10 or 15 miles above its mouth. On the B.S.A. Co.'s map the Myatambesi is rightly shown as a feeder of the Matetsi, but, presuming it to be the Lukunguli, its course is quite incorrectly represented.

Like all the larger southern streams, the Lukunguli heads on the plateau in wide grass-covered loam-flats, which form a shallow basin bounded by higher forested sand-veld. On the north this sand-veld separates the basin from the direct Zambezi drainage, and on the south

it spreads across the subsidiary watershed and covers a large part of the long descent into the main basin of the Matetsi. The alternation of loam-flats and sand-bults, with occasional interspaces of rocky ground, is the prevalent characteristic of the less broken portions of the plateau, as I have elsewhere described * and illustrated by the figure here reproduced (Fig. 19).

The mapping and nomenclature of the middle reaches of the Matetsi with its tributaries also require rectification, toward which, however, I can contribute little. What was considered by Chapman and Baines—correctly, as I think—to be the main stream, receiving numerous feeders from the south, is shown on the official map as the Machumpa river, and the Matetsi is given an independent course farther westward. The error has probably arisen from a misinterpretation of a sharp bend in the Matetsi, some 3 miles west of the railway-crossing, which appears to bring the river in from the north-west; but we found that another bend toward the opposite quarter soon counteracted the effect of the first. The natives whom we questioned knew the Machumpa only as a small spruit, tributary to the Matetsi.

The Chichigumba river of my sketch-map is that shown as the Chinjagumba on the official map. It is probably the largest of the upper feeders of the Matetsi, and indeed appeared to me to be at least equal in consequence to the Matetsi near their confluence. In direction and in the features of its basin, it bears much resemblance to the



Lukunguli, except that the comparatively high level of its confluence prevents its valley ever attaining the abruptness and depth of that of the lower Lukunguli.

* *Quart. Journ. Geol. Soc.*, vol. 63, pp. 169-170 and fig. 1.

On our rapid southward journey from Lukubiro's kraal (Jaraban's kraal of the B.S.A. Co.'s map) in the Chichigumba basin to the head of the Deka valley, we crossed the Matetsi river not many miles below its head. Here it had no definite valley, but was merely a trickling stream, with long narrow water-pools, confined by low banks on an open plain. Some of its little feeders, however, have excavated irregular valleys in the higher country to the southward, where flat-topped ridges rise against the sky-line.

The broad high strip of tree-covered sand-veld, called by Chapman the "High land of Boomka," that lay across our route between the upper basin of the Matetsi and that of the Deka, may be regarded as a northern spur of the Kalahari that has not yet been broken up by the tributary drainage of the Zambezi system. It holds the characteristic shallow pans or vleys, with no outlet, which contain water for a short time during the wet season; and at its southern edge we passed a small pit-like water-hole of the Kalahari type, sunk 8 or 10 feet below the general level. The descent from this country to the Deka basin was very gradual, but unfortunately it was night before we reached that river, and darkness hid the transition from me.

The Deka basin, so far as it lies within the basalts, is generally similar to that of the Matetsi. Its south-eastern side is, however, of different aspect, as a result of the sudden change in the country-rock from basalt to sandstones and coal-bearing shales along the great "Deka fault;"* and on this side, the valley is fringed with tabular kopjes that become relatively higher and more rugged as the basin becomes deeper. It appeared to me that the average direction of the Deka river from its headwaters to beyond the Wankie coalfield is approximately east-north-east, and that it is placed too far southward on the recent maps, which give it a north-easterly course. But my observations were not of a character to enable me definitely to fix its position.

Concluding Notes.—A more particular and localized description of the plateau and of the country generally along our routes will be found in the short itinerary printed as an appendix to my paper on the geology of the region (*op. cit.*, pp. 213, 214). It may be added that the hazards of the country to the traveller are increased by the great scarcity of conspicuous features to serve as landmarks where the plateau is unbroken, and by the general similarity of the ravines where it is dissected. South of the Matetsi, however, on the southern side of the Zambezi, and east of the Gwemansi on the northern side, where the ground has been more broadly carved away, there are usually hills of recognizable shape when a distant sky-line is in sight.

The average level of the plateau falls decidedly toward the Zambezi both from the north and from the south, and it also sinks eastwards

* *Quart. Journ. Geol. Soc., op. cit.*, pp. 178-180, and figs. 2 and 3.

until the Deka is reached. These gradients probably pertain to its original structure, but have been greatly accentuated by erosion. If it should ever be worth planning irrigation on an extensive scale in the Zambezi basin, water could therefore be conveyed by gravitation from above the Victoria Falls to the more easterly portion of the plateau and its valleys.

I append a series of aneroid readings taken at intervals along our route. Though not likely to have much value as absolute measurements of altitude, they will serve as indications of the relative levels. The weather remained uniformly placid throughout our journeys—cold nights and bright hot days with clear skies, except on three days when scattered packs of white cloud sailed up in the afternoon.

For the photographs with which this paper is illustrated I am indebted to the kindness of Mr. F. W. Sykes, and of Miss Louisa Rhodes (acting as the representative of her brother, the late Colonel F. W. Rhodes, who accompanied us on our journey north of the gorge). I have also to thank the Council of the Geological Society for permission to reproduce Figs. 8, 11, 12, 13, and 19; and the Council of the British Association for the same privilege in Fig. 1.

APPROXIMATE ALTITUDES, FROM ANEROID OBSERVATIONS, IN THE ZAMBEZI BASIN AROUND THE BATOKA GORGE.

Note.—The instrument used was a Stanley's 2½-inch aneroid, compensated. In the altitudes given below, the actual readings have been adjusted in accordance with fixed levels on the Bulawayo-Victoria Falls railway at the places where I could compare these with the results yielded by the instrument. The figures can be approximations only, but the instrument gave fairly consistent results throughout.

For the following supplementary altitudes I am indebted to the officers of the Rhodesia Railway Company: *Victoria Falls railway station*, 2994 feet; *Victoria Falls bridge* (rail-level), 2876 feet; *Kesi siding* (on plateau north-west of Matetsi), 3489 feet; *Matetsi station*, 2804 feet; *Katuna siding* (between Matetsi and Deka bridge), 2987 feet; *Deka bridge*, 2292 feet; *Wankie station*, 2448 feet; *Bulawayo*, 4469 feet.

I was informed by Mr. G. C. Imbault (who had charge of the construction of the Victoria Falls bridge) that a measurement of the middle portion of the Victoria Falls by triangulation gave the height as 357 feet; the dry-season water-surface in the gorge beneath the Falls will therefore be at an altitude of 2540 feet.

The altitudes are in feet above sea-level (Cape datum).

Where the opportunity occurred, readings were taken at different hours, and in these cases the average is given, and the number of separate observations is indicated by the figures in brackets.

THE BATOKA GORGE.

Locality.	Crest of the gorge, or nearest available point on the plateau adjacent.	Bottom of the gorge, usually on the flood-platform	Remarks.
	Feet above sea-level.	Feet above sea-level.	
Victoria Falls	2900	2540	See note above.
Near confluence of Songwi river	(6) 2680	(2) 2220	Depth of gorge, 469 feet.
Mavangu camp	(3) 2830	-	
Chimamba cataracts	(3) 2430	1780	" " 650 feet.
Highest point on route between Mamba river and Karamba river	2720	-	
Karamba camp and confluence	(7) 2450	1630	" " 820 feet (but less at actual crest).
Opposite to Namaruba confluence (south side of gorge)	(2) 2420		
In hollow on crest at south side of gorge	(2) 2280	(2) 1590	Depth of gorge, 830 feet.
At Matetsi confluence	-	1470	
Makwa (Wankie's drift)	*	(3) 1440	* Baines gives 1550 feet for his camp on Logier hill; and Mohr, 1680 feet for Wankie's kraal.

MATETSI BASIN (GOING UPSTREAM).

Locality	Feet above sea-level.
Sand-bult between Gongobujo river and Matetsi river	2180
Cheza's kraal, in Matetsi valley, 4 miles above mouth	(4) 1590
Plateau in north angle between Matetsi and Lukunguli rivers	(4) 2020
Shantete's kraal, in Lukunguli valley	(4) 2220
Dambi's kraal, at head of Lukunguli valley	(2) 2790
Watershed between Dambi's kraal and Matetsi railway-station	3040
Matetsi river at ford, 4 miles west of Matetsi station	2850
In north angle between Matetsi and Chitshigumba rivers	(2) 3080
Lukubiro's kraal (formerly Jaraban's), Chitshigumba valley	(2) 3210
Matetsi river at highest crossing, near Pandamatenka road	(2) 3180
South side of Matetsi basin, near its head, at Matheison's	(3) 3380
Boomka sand-bult, between Matetsi and Deka basins	(2) 3620

DEKA BASIN (GOING DOWNSTREAM).

Locality	Feet above sea-level.
Upper valley, near Deka	(4) 3450
First camp in valley below Deka	(8) 3390
Bumbusi camp, south-east side of Deka valley	(2) 2870
Mutoro's kraal (between Bumbusi and Ngoni's)	(2) 2530
Nzoni's kraal, on low terrace of Deka river	(2) 2390
Deka railway bridge (see above)	2292
Deka valley at Rondulu confluence, 6 miles north of Wankie station	2150
Makwa (Wankie's drift), near mouth of Deka river (see above)	1440

LIEUT. COMYN'S SURVEY OF THE PIBOR RIVER.

ONE of the principal upper branches of the Sobat has for some years been known to be the Pibor, which joins the Akobo from the south a little short of 8° N. lat. It was ascended a short distance by Lieut.-Colonel (then Major) Maxse in 1898, but, owing to difficulties caused by the sudd, little further was done to explore its course until, in 1904, a successful ascent to a point far to the south was made by Lieut. Comyn, of the Black Watch, in the gunboat *Abu Klea* (apparently the same in which Major Maxse had visited the river). Lieut. Comyn has sent us a detailed account of his voyage, accompanied by a copy of his survey, which is here reproduced on a smaller scale. The following notes embrace the most interesting parts of the narrative.

The amount of sudd appears to have been less than usual in August,



THE PIBOR RIVER

1904, the month in which the ascent was begun. After passing his predecessors' farthest, Lieut. Comyn steamed across a lake-like expansion covered with thin sudd, and soon found a clear stream, about 20 feet deep, running between banks about 200 yards apart, crowned with a belt of thorny bush, beyond which lay a large treeless plain, with a line of *heglig* trees (*Balanites ægyptiaca*). A herd of elephants was seen, as well as other game, including giraffe in extraordinary numbers, all being very tame. A belt of sudd had to be cut through, and beyond this the waterway dwindled to from 20 to 50 yards, though the belts of bush were still 100 yards apart. About 50 miles beyond the mouth of the Agwei, traces of human inhabitants were seen in the shape of rude shelters about 3 feet high, with fishing-baskets, etc., lying about. Leaving the chief engineer, Mr. Sharples, to superintend the cutting

PIBOR RIVER

From a Prismatic Compass Sketch
by
LIEUT. D COMYN Black Watch.
1904

Scale 1:1,750,000 or 1 inch = 28 stat miles

20 - Depths in feet

Giraffe and Elephant
To N banks 100-800 yds apart to S 100-200 yds

North of this point the bush is about 1/2 mile broad on either bank no big trees to the South the bush averages 1 mile on either bank plenty of timber

Depth of river at Nyannabek on journey up 1000 ft it rose 8 ft in 7 days after heavy storms

Pibor R Anuak name (N of Agwei R) Nyannabek
Nuer name King Agibba name (until) Average current 5 miles per hour waterway 80 yds wide depth 20 ft

J Lekchur
Open Plain

Alelethi
Melameth

(Mangobal)
Lime & lush river enters plain

Scattered dwarf hashak

Plain under water

Farthest point reached by gunboat

Farthest point reached by Heald boat

Water 1/2 ft deep

NUER

Mabo R

Dinnma

ANUAK

Agwei R banks 60-80 yds apart waterway 80 yds depth 18-20 ft current 2 1/2 miles per hour

Agwei R

Shortly beyond point reached the Agwei R is reported to divide one branch coming from the Abyssinian Hills occupied by Anuaks the other by Agibbas The ground between the branches high

Giraffe

summer quarters of the Agibba tribe They state that the river dries up N of this

Nyannabek

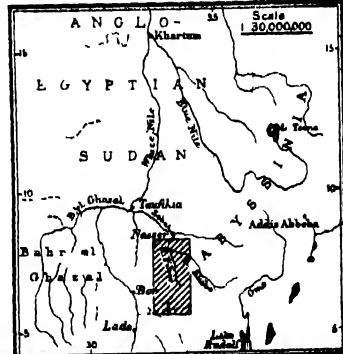
B A

Open

Plain

J Arin

Melameth



through another belt of sudd, Lieut. Comyn went on in the launch, and came upon inhabitants, who at first deserted their village, which lay behind a belt of trees, and proved to bear the name Nyanabek. Relations were at length established, after some hostile demonstrations had been quieted by the firing of a gun, which produced a great effect. The people, who gave their name as Ajibba, seemed to be a strongly organized tribe, at feud with the Nuers, whom they hold in great respect while despising the Anuaks. In appearance they are unlike either of these, being more like the peoples of the western Bahr-el-Ghazal. The average height seemed to be about 5 feet 6 inches. The young men had their hair arranged like an inverted soup-plate, the front portion being cut off. Across the forehead they wore a band ornamented with beads, and from the centre of the under-lip depended about 8 inches of chain or thin wire. Rings were worn in the ears, and on the arms armlets and rings of ivory, rhinoceros-horn, and metal. A small carved stool, which also served as a head-rest, was carried under the arm. The wrist-knife and spears had their edges encased in sheaths of giraffe leather. The older men wore a bowl-shaped hat of felt, and a large tuft of giraffe-tails just above the elbow. In conversation they had a strange way of arranging their persons according as they listened or spoke, before doing which last they rang a bell which they carried. The Ajibba seemed to possess a good number of cattle and sheep, and cultivated durra and tobacco. They appeared quite ignorant of weaving, and nothing resembling cloth was seen among them, but their leather-work gave evidence of much skill.

Beyond Nyanabek the gunboat steamed past a number of villages consisting of five or six huts each. The bush soon closed in on the river, but was submerged to a depth of several feet. A hill was sighted, which formed a landmark for many miles. The waterway became narrow and excessively tortuous, with an almost imperceptible current, and at last became quite closed by sudd, but by casting off the sandal (barge), it was found possible to force the gunboat through. On emerging into a broader channel, the water appeared whitish, probably owing to a storm on the plain beyond. The trees hereabouts changed from *nebbuk*, *kuk*, etc., to little else than *takl*. More villages of Ajibba were reached, but the people showed themselves hostile, though they gave the information that the hill above mentioned was named Atin. The course led past the foot of this, and another mountain was soon sighted. The river broadened into a lake-like expanse, with a treeless plain to the north and west, and slightly rising ground to the south. Fuel was now almost at an end, but an attempt was made to push west, in which direction the plain was traversed by a band of light-green grass, with here and there a space of open water. Fortunately, when the last pound of fuel was being used, a wood of *takl* trees, waist-deep in water, was reached, from which a fresh supply was obtained by three days'

hard work. The wood was alive with birds, mostly black, and of the size of large ducks, producing an extraordinary spectacle. Very soon afterwards the increasing shallowness and the thick grass made further progress in the gunboat impossible, but having sighted a forest in the distance, Lieut. Comyn started for it in the Hielop boat, and when even this could be poled no further, did the last few miles by wading. The boat was once more reached at nightfall, and was only found thanks to the precaution which had been taken of tying a sheet to the mast. The wood which had been reached, consisted of enormous *heglig* trees, and contained many birds' nests, but the eggs—of the size of a turkey's—some of which were boiled and eaten, proved most unpalatable.

During the return voyage the hill Atin was climbed, and from its top the course of the river could be traced for miles. It appeared to lie in a belt of bush, but to be nowhere joined by any other stream. The hill was composed of a red and black granite. The Ajibba in its neighbourhood declared that their tribe extends to the Abyssinian hills, and that they also dwell on the Agwei. Progress down-stream was comparatively easy, and on reaching the Agwei, Lieut. Comyn decided to explore it in the launch. Within the mouth he found it a fine river, 18 feet deep, and running for the most part between banks several feet high. Some belts of sudd had to be negotiated, but only one seems to have caused serious trouble during the ascent, though the difficulties were somewhat greater on the return. On the banks bush and plain alternated, with some fine trees, but at one part the country was flooded. Giraffe were seen, and many egrets and other birds. One of the crew was wounded by a crocodile, and on reaching a solid mass of sudd between high banks, Lieut. Comyn was forced to turn, reaching the steamer after an absence of three days, and proceeding at once to the Nasser post, where much-needed supplies of flour, rice, and sugar were procured.

DR. RICE'S EXPLORATION IN THE NORTH-WESTERN VALLEY OF THE AMAZON.

By Colonel GEORGE EARL CHURCH.

BETWEEN the Rio Negro tributary of the Amazon and the Andes is one of the most interesting and unknown regions of South America, replete with unsolved geographical problems. It is traversed by numerous great rivers, which have their sources on the eastern slopes of the Cordillera south of Bogotá. Some of these streams have been partially although rudely explored. I have called especial attention to this vast area of country in my 'Desiderata in South American Exploration,' published by our Royal Geographical Society last year, as offering a splendid field of geographical study for some hardy and adventurous explorer. My friend Dr. H. Rice, a graduate of Harvard University,

has found the bait too alluring to resist, and, at his own expense, is, with rare courage and intelligence, now unravelling, as it were, the confusion that exists regarding the sources of the Guaviare, the Ynirida, the Rio Negro, and the Uaupes. The following letter, which I have just received from him, will give a faint idea of the magnitude of the work to which he is devoting his energies and resources :—

“ La Sal, Rio Guaviare, Colombia, November 5, 1907.

“ MY DEAR COLONEL,

“ There is a canoe just starting for San Martin, and I take this opportunity to send you a line. I reached Unilla September 29, which river is the north branch of the Uaupes. I was there a month, and I returned here in order to place the source of the river Ynirida, which is eight days to the east of here. The Rio Negro rises in the hills just south of Puerto Alturo, which is at the point where the Rio Ariare debouches into the Guaviare, five hours above here by canoe, and from where I started through the Vega de Caqueta to the Uaupes. I am returning there to-day or to-morrow for more observations, and also to study the hills more carefully, as I think that they are the remnant of coast-line of the ancient Amazonian sea, the evidence of which I shall submit to you later. I return soon to the Unilla, and thence descend to the river Itilla, stay there awhile, and then go down the Uaupes very slowly.

“ The so-called Vega here is a dense forest, rich in rubber, and watered by hundreds of *caños* (natural canals), which contribute to the difficulties of travel.

“ I have acquired a vocabulary of 100 words or so of Carigona, Huilote, and Anagua Indians, and have a great fund of things to tell you when we meet.

“ I enclose two maps which I have just drawn, very hastily. They are not to scale, but may give you an idea of how things are situated here from a cartographical point of view.

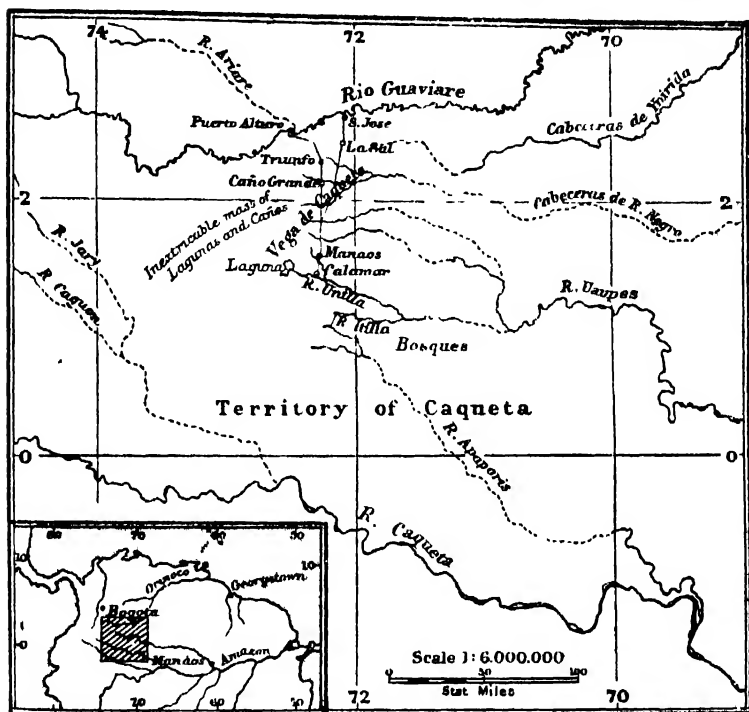
“ I am going very slowly, studying everything carefully, and coming only to conclusions after long meditation. If I am in doubt about anything, I return to work over it again. I have compared Broca's scale of colour with every Indian I have seen, and they are a light brown-yellow or dark olive invariably. The eyes are markedly Mongolian, and the face broad and flat, and many points to make us think them having migrated from elsewhere, but the more I see of them the more I am convinced that they are the product of the soil here, the same as any long-isolated organism. I have followed up their religion, etc., and all these points you shall have later.

“ Yours sincerely,

“ HAMILTON RICE.”

Up to the present time, the river Unilla has been mapped as a

branch of the Guaviare affluent of the Orinoco, according to the explorations of Crevaux, but Dr. Rice makes it the north branch of the "Uaupes, thus extending the drainage basin of the Amazon to within about 90 geographical miles of the city of Bogotá. Wallace, who explored the lower Uaupes, a great western branch of the Rio Negro, was "strongly inclined to believe" that the Ariari and other rivers credited as sources



ROUGH SKETCH-MAP TO ILLUSTRATE DR. H. RICE'S EXPLORATIONS IN THE
NORTH-WEST AMAZON REGION, 1907.

of the Guaviare, were in reality those of the Uaupes. His supposition was incorrect as regards the Ariari, but as to the Unilla is confirmed by Dr. Rice.*

It seems that Dr. Rice is now about to complete the exploration of

* Dr. Koch of Berlin, who in 1904 ascended the Uaupes farther than any of his predecessors (*Zeitschrift, Berlin Geographical Society*, 1906, pp. 89-91), found it still an imposing stream in 71° W. He was told that four days higher up it was formed by the junction of two streams, one from the west, the other from the north, which would seem to be the Itilla and Unilla of Dr. Rico. Dr. Koch says that the Umuama, a tribe of Carib stock, roam over this region. The Unilla of previous maps is, it should be noted, the stream shown in our sketch-map as joining the Guaviare just west of 74°.

this river, and we cannot but wish him every success in his dangerous but extremely important task. In his letter, above quoted, he mentions a tribe of Indians, the Anaguas, but I am not quite sure whether the word commences with A or O. It may be Omaguas, which would make them a fragment of the race of this name which once occupied such a vast region on the upper Amazon and the rivers of Ecuador. If some of them are still found at the headwaters of the Guaviare, it is interesting to ethnologists.

REPORT OF PROGRESS IN THE INVESTIGATION OF RIVERS.*

By A. STRAHAN, Sc.D., F.R.S.

THIS investigation was commenced in 1906 by aid of a Government grant of £150 per annum for three years, supplemented by a grant of £50 by the Royal Geographical Society. The object is to ascertain—

- (a) The discharge of rivers in winter and summer, and the total annual discharge.
- (b) The suspended and dissolved impurities in wet and dry periods, and the total amount carried in the year.
- (c) The rainfall in different parts of each river-basin.
- (d) The area of each basin, and the elevation of different parts of it.
- (e) The area occupied by calcareous and non-calcareous formations, and by pervious and impervious formations.

At my invitation, Dr. A. J. Herbertson and Dr. H. R. Mill joined me as a committee, the latter undertaking to furnish records of the rainfall. Subsequently, Mr. N. F. MacKenzie consented to become a member of the committee, and to give the benefit of his wide experience in gauging rivers and canals in India.

The committee have had also considerable assistance from Mr. E. F. Elton and Mr. H. O. Beckett in many branches of the work, more especially in levelling, sounding, and measuring river-channels, in tracing water-partings, and in the computation of areas.

To Prof. W. H. Lewis, of the Albert Memorial College, Exeter, the committee is indebted for periodical examinations of the suspended and dissolved impurities in the Exe.

THE EXE AND ITS TRIBUTARIES.

Work was commenced on the Exe. The Exeter City Council, in reply to a letter describing the nature of the investigation, promised assistance in every possible way as far as it related to this river. A gauge, furnished by the committee, was fixed by Mr. Thomas Moulding, the city surveyor, at Exeter quay, and is being read daily by one of his staff. The river is here confined to a single channel of fairly uniform breadth and depth, and seemed suitable for determinations of volume. The channel was therefore sounded for a measured length of 100 feet, and velocity-observations have been made as frequently as possible. A record of floods since 1866 has been kept at a boat-house close by. By levelling from the flood-marks to the gauge the committee has been able to add this record to its recent observations.

* Research Department, November 15, 1907.

About 5 miles above Exeter, the Exe receives the Creedy on its right bank, and the Culm on its left bank. Gauges have been erected on both of these rivers, and on the Exe above the confluence, and are being read daily. Velocity-courses have been measured on the Creedy and the Exe close to the gauges, and observations on the current have been made when practicable. The course on the Exe seems to be satisfactory, but that on the Creedy may have to be changed, inasmuch as flood-water of the Exe may under certain conditions run up the Creedy as far as the spot selected. The Culm presents considerable difficulties, for when in flood it spreads over a broad alluvial flat and fills a number of temporary channels. The best method of dealing with this stream is still under consideration. In the mean time the gauge is read daily by Mr. Charles Gray, engineer to the Silverton Paper Mills, who has kindly also consented to collect samples of water periodically. The Creedy gauge was fixed and is read by men in the employment of the city surveyor.

The rate of passage of floods down the Exe being a matter of interest, the readers of the gauges have been instructed to make hourly observations when a rapid alteration of level is taking place. With the same object in view, a gauge has been erected in the Exe near Dulverton, about 22 miles above Exeter. The gauge was fixed by kind permission of Mr. T. F. Tracy at his Exe Valley Fishery, and is being read daily and hourly when desirable.

The water-supply of Exeter is taken from the Exe between these upper gauges and Exeter quay. The amount taken is known, and will be allowed for. The outflow of these rivers above their confluence, with the amount added, should approximately equal the outflow at Exeter quay.

The observations made so far by Prof. Lewis have shown that the amount of matter carried in suspension by these rivers when in normal condition is extremely small. Half a gallon of water does not yield sufficient material to weigh, and preparations are being made to collect larger quantities. No opportunity has yet arisen of examining the water of a high flood.

During violent floods sand and gravel are rolled along the bottom. No reliable method of determining the amount rolled has ever been devised, but, in the case of the Exe, the committee hope to get a satisfactory estimate by aid of the city surveyor. For some years gravel has been dredged from a reach above Exeter in just sufficient quantity to keep the channel at a constant depth. A record of the amount dredged is promised to the committee.

The areas of the Exe basin above Exeter quay, and of the Creedy, Exe, and Culm basins above the upper gauges, are being measured on the 6-inch maps by Mr. E. F. Elton. This necessitated an examination on the ground of much of the water-parting by Mr. Elton and Mr. Beckett, it having proved to be impossible to determine the parting with sufficient accuracy on any existing map. At the same time computations of the areas above and below certain altitudes, and of the areas occupied by various geological formations, are being made.

THE MEDWAY.

The Medway having been canalized, its flow is controlled by sluices and affected by the working of locks. Occasional observations on the water-level or on the current are therefore useless, and attempts are being made to obtain a continuous record of the water-level at two spots about $1\frac{1}{2}$ mile apart. For this purpose two water-level recorders, worked by clocks, have been established, one by permission of Mr. W. E. Martin in his garden in Maidstone, the other by permission of Mr. Randall Mercer in his boathouse near Allington lock. The relative level of the gauges is being determined, and the capacity of all parts of the channel between them will be ascertained as soon as practicable.

The committee is also making arrangements for the collecting and examining of samples of the water in the various conditions of the river. The amount of suspended matter carried by the Medway appears to be far greater than that carried by the Exe, and great importance is attached to the obtaining of reliable data.

The committee desire to express their obligation, not only to the gentlemen named above, but to the Lower Medway Navigation Company. By permission of the chairman, Mr. John Arcoll, the site was prepared for the lower gauge by the staff of the Navigation Company, under the superintendence of Mr. John Rose, their lock-keeper at Allington.

It is to be regretted that considerable irregularities in the clocks have delayed the commencement of a continuous record. Detection of the cause of error necessitated frequent journeys to Maidstone, and in this the committee are now receiving the assistance of Lieut.-General Charles Strahan, R.E.

OTHER RIVERS.

The Severn is a river which it will be desirable to investigate as soon as possible. Some years ago the flow at Worcester was determined with great accuracy during a period of several months by Mr. G. F. Deacon. The committee contemplates the erection of a gauge at Worcester, and periodical examinations of the water under various conditions of current. Mr. Deacon has kindly consented to allow the publication of his results in connection with such observations as may be made by the committee.

It will be desirable, also, to investigate a river which drains a chalk area, such possibly as the Salisbury Avon, with a view to ascertaining the effect of so absorbent a material as chalk on the relation of rainfall to flow-off.

In conclusion, the committee desire to call attention to their urgent need for volunteer observers. Velocity observations should be made as frequently as possible during the rainy seasons. The courses having been measured and staked out, the actual observations are easily and quickly made. Travelling to the spot constitutes the most serious part of the work, but in all cases the courses have been selected as far as possible with a view to their accessibility. In all other branches of the work, also, further assistance is urgently wanted. Rainfall observers in the upper parts of the valleys of all the rivers named could render useful services, and more rainfall observers are required in the case of the Salisbury Avon in particular.

NOTE ON MEASUREMENT OF AREAS IN THE EXE BASIN.

By E. F. ELTON.

The geology of the Exe basin having been put upon the 6-inch map, it was necessary to insert the boundary of the basin. This was generally fixed closely enough by the data of the map; where these data were insufficient I walked over the ground, and thus put upwards of 70 miles of watershed on to the map in the field. In one case the observed line differed from what the map suggested by a plot of some 200 acres; this was exceptional, but the aggregate change was considerable. This suggests that watersheds would be an interesting and useful addition to the Ordnance maps.

The basin requires 133 sheets. These vary much in dimensions. Of the fifty-four measured up to the present, only four have both dimensions correct. The variations range from 0.01 foot of shrinkage to 0.012 foot of stretching. As I am using an Amsler's planimeter with an adjustment for such variations, they do not add materially to the labour.

The measurements are checked as each sheet is finished. The error is in the fourth (rarely the fifth) figure, which, considering the other elements involved, appears to be a satisfactory result; and this error distributes over the various sections of the sheet in proportion to their area.

NOTE ON THE MEASUREMENT OF DISCHARGES OF THE EXE AND MEDWAY RIVERS.

By N. F. MACKENZIE, M. Inst. C.E.

The discharge of any channel is given by the area of its cross-section multiplied by its mean velocity. The area of the section is got by direct measurement, and the problem that presents itself is therefore the determination of the mean velocity. This may be arrived at in various ways, of which the most usual are --

From velocity-rod observations.

From current-meter observations.

From surface velocities.

From the slope of the water-surface.

From velocities at different depths got by sub-surface floats.

The velocity of a floating weighted rod reaching from the surface nearly to the bed is found, by experiment, to be for all practical purposes the mean velocity of the vertical plane in which it moves, and velocity rods are almost universally used in India for the measurement of canal discharges. Unfortunately, river-beds are, as a rule, too irregular to admit of their use.

Under favourable conditions, the current-meter may be expected to give good results, but the men on whom we have to rely for the observations have had no previous experience in its use; and, apart from this, the time occupied by current-meter observations is far greater than we could expect them to place at our disposal.

It was therefore decided that, whenever possible, the mean velocity should be calculated from observed surface velocities, using a coefficient or reduction multiplier. The coefficient varies with the *rugosity* of the channel, a term which includes all obstructions or irregularities which interfere with the free flow, and it also varies with the hydraulic radius of the channel. The coefficient is therefore not constant even in channels of the same rugosity, nor in the same channel for different gauge-readings.

In selecting a coefficient for reducing surface velocity to a mean velocity, we fortunately have accurate data at our disposal. For many years Indian irrigation engineers have experimented on the relation between surface and mean velocities, and on these experiments are based tables of coefficients which are accepted as correct for all purposes of discharge calculation. Indeed, some irrigation engineers consider that surface-velocity observations give results even more reliable than those obtained from velocity-rods.

The difficulty in the method lies in the proper determination of the rugosity of the channel. This is a matter of expert knowledge, but is comparatively easy for any one who has had experience in this method of measuring discharges.

Measurement of the surface velocity presents no difficulty. The river is divided into longitudinal sections, and floats are run over a measured distance, usually 50 or 100 feet, the time of passage being noted. The mean of several runs is taken for each section, and the length of run divided by the time of passage gives the surface velocity of the section.

Having obtained a series of measured discharges for various gauge-readings,

a discharge-table is drawn up by interpolation, due allowance being made for the variations of the coefficient owing to the altered value of the hydraulic radius. The above is the method adopted for the Exe and its tributaries.

On the Medway, which is canalized, the conditions are different, and a gauge reading gives no indication of the volume of water passing down the river, as navigation depth is maintained by manipulation of the lock-sluices, whatever may be the discharge. It was therefore decided to calculate the discharge from the slope of the water-surface, the slope being got from two gauges at a known distance apart, with their zeros fixed at known levels for comparison. As the conditions governing the surface slope are continually altering, it is necessary that the gauges should be self-recording.

Given the slope of the water-surface, the mean velocity is got from the expression $v = C\sqrt{RI}$, where R is the hydraulic radius, and I is the fall of the water-surface in unit-length. C is a coefficient which varies with the rugosity, surface slope, and hydraulic radius. The equation for C which it is proposed to use is the well-known formula of Kutter, which is based on the experimental investigations of Kutter and Ganguillet—

$$C = \frac{\left(41.6 + \frac{1.811}{N} + \frac{0.00281}{I}\right) \sqrt{R}}{\sqrt{R} + N \left(41.6 + \frac{0.00281}{I}\right)}$$

where N = Kutter's coefficient of rugosity.

Calculations based on this somewhat formidable expression are much simplified in practice by the use of hydraulic tables, such as those of Higham or of Jackson, in which values of C are worked out for channels of various sizes, slopes, and degrees of rugosity. Intermediate values to suit existing conditions can be obtained by interpolation between the values given in the tables.

As in the case of the Exe, the selection of the proper coefficient of rugosity is the difficult part of the problem. The most satisfactory method will be to measure one or two discharges by the surface-velocity method, and from these calculate the appropriate value of the coefficient, which will then be applied to the surface slopes from the gauge records.

As regards the probable accuracy of the selected methods, it has been found by actual experiment on Indian canals, that surface velocities give discharges varying by not more than half per cent. from those deduced from velocity-rod observations.

The surface-slope method of calculation is more adversely affected by an error in the estimated value of the coefficient of rugosity, but if the appropriate coefficient for the Medway be determined by measurement of surface-velocity discharges, the error is not likely to exceed 1 per cent.

ON THE OBSERVATIONS OF RAINFALL.

By HUGH ROBERT MILL, D.Sc.

THE voluntary rainfall observers in all parts of the country furnish data which make it easy to produce small-scale maps showing the monthly or annual rainfall of the British Isles as a whole with considerable accuracy; but when comparatively small areas are dealt with on a large scale, the chance distribution of observers often fails to allow a satisfactory map to be drawn. I have accordingly endeavoured to enlist the services of new observers in the Exe and Medway valleys, so as to fill

up the larger gaps and make it possible to determine the volume of rainfall of any year or month with considerable accuracy, and that of any day with fair accuracy.

There are now at work in the Exe valley or on its margin, sufficiently near the watershed to give useful indications, fifty-four observers of rainfall, most of whom keep daily records. In the Medway valley the representation is equally good, and it was only found necessary to supply rain-gauges from the funds of the committee to six altogether.

The comparison of rainfall with stream-flow will involve considerable difficulty, as the general fall over the whole valley on any one day cannot affect the stream at the point where it is gauged at the same time. It will probably be found necessary to discuss heavy local rains in different parts of the basin in some detail, in order to ascertain how soon the rain finds its way down the stream, and to be guided by the result in carrying on the more general discussion. It is desirable to wait until a considerable number of heavy falls have occurred within the period of the river gaugings before proceeding to make this comparison. At present the accumulation of data is proceeding in a satisfactory way.

OBSERVATIONS OF GLACIER MOVEMENTS IN THE HIMALAYAS.

WE quote below, with a few omissions and additions, the Introductory Report furnished by Mr. T. H. Holland, F.R.S., Director of the Geological Survey of India, to the detailed descriptions of the work recently carried out by his officers * in the observation of the movements of Himalayan glaciers.

"In 1905 Mr. D. W. Freshfield, on behalf of the Commission Internationale des Glaciers, drew the attention of Lieut.-Colonel S. G. Burrard, F.R.S., Superintendent of Trigonometrical Surveys, to the importance of recording data for determining the secular movements of the principal Himalayan glaciers. As the work required the co-operation of all officers and private travellers likely to visit the glacier regions of the Himalaya, Colonel Burrard referred the question to the Board of Scientific Advice, and, on the recommendation of a sub-committee composed of Colonel F. B. Longe, R.E., Surveyor-General, Dr. G. T. Walker, F.R.S., and myself, the Board agreed on a system of observations, recommending that the distribution of the necessary information and collection of data should be under the control of the Geological Survey Department. The proposals having received the sanction of the Government of India, the first step in the investigation was taken by the deputation of five Geological Survey officers during August and September, 1906, to make a preliminary survey of the principal glaciers in the Kumaon, Lahaul, and Kashmir regions.

"Altogether twelve glaciers were examined, as follows:—

"*Kashmir Region.*—The Barche and Hinarche glaciers in the Bagrot valley; the Minapin, Hispar, and Yengutsa glaciers in the Nagir State; and the Haseanabad glacier in Hunza. These six were surveyed by Mr. H. H. Hayden.

"*Lahaul.*—The Bara Shigri and Sonapani glaciers were examined by Messrs. H. Walker and E. H. Pascoe.

"*Kumaon.*—The Pindari, Milam, Shan Kulpa, and Poting glaciers were surveyed by Messrs. G. de P. Cotter and J. C. Brown.

* 'Records of the Geological Survey of India,' vol. 35, parts 3 and 4 1907. London: Messrs. K. Paul, Trench, & Co.; Calcutta: Geological Survey Office.

"In all cases plane-table sketches were made, showing the exact positions of the ice-caves with reference to points cut and painted on rocks in the valley, as well as with prominent and unmistakable peaks in the vicinity. In some cases cairns were built over the marks, and in the Kashmir area these were placed in charge of the nearest village headmen. The cairn built near the Milam glacier was placed in charge of Bai Bahadur Kishen Singh, who is well known to science as 'A.-K.'

"Photographs were taken from various points of view carefully marked on the map and described in the report, showing the state of the glaciers and the principal masses of moraine material at the time of the visit. These photographs will enable subsequent travellers to form an idea of any changes that may have occurred in the interval, and will thus make their observations of value even if the fixed points cut in the rocks are destroyed by weathering or by being overwhelmed with loose material.

"The short time available rendered it necessary that observations should be confined to one aspect of the glaciers, namely, that of their secular advance or retreat. It was impossible, under the circumstances, to make more than passing observations on such questions as the rate of flow, the lamination of the ice, included dirt bands, and erosive action. These interesting questions must be left for future workers, as it was important in as many instances as possible to fix at once, for the purposes of the main problem, the positions of the snouts and general disposition of the ice with regard to fixed features in the ground around.

"The first point that strikes one on examination of the reports is the fact that the glaciers of the Hunza valley and the Karakoram range generally descend to lower altitudes than in the Lahaul and Kumaon regions. In the former region the snouts of the glaciers proceed down to levels of 7000 or 8000 feet, while in the latter region they melt before descending below the level of about 11,000 feet. [In the Kangchenjunga group the lowest point reached by ice is about 13,000 feet in the great Zemu glacier.] In the Hunza region, also, there are two classes of glaciers—

"(a) Those which flow transversely to the trend of the mountain range, and are relatively short, with a steep descent reaching down to elevations as low as 8000 feet and under; and

"(b) Those which lie in troughs parallel to the range, and also approximately parallel to the strike of the rocks of which the range is composed. These, having at their angles of slope a less rapid fall, rarely descend below 10,000 feet, and form long glaciers, in some cases making the most magnificent ice-flows in the Himalayas."

The second point prominently displayed is the evidence of general retreat shown by the occurrence in nearly all cases of old moraines (sometimes grass-covered) below the present ice. This point does not, of course, necessarily mean that the glaciers are now in retreat, and two well-authenticated cases of recent advance have been found in the Yengutsa and Hassanabad glaciers, both steep transverse ice-streams. Since 1892, the date of Sir M. Conway's visit, the Yengutsa glacier has advanced at least 2 miles, nor does this advance appear to have been gradual, as, according to local reports, the ice moved forward suddenly some five years ago, and has since remained stationary. The Hassanabad glacier, according to the statement of the Emir of Hunza, also moved forward suddenly some three years ago, covering in two and a half months a distance variously estimated as from 6 miles to one day's march. Owing to the danger involved to the villages near, it was carefully watched, and the above statements may, we are told, be accepted. It is said that the ice occupied its present position many years ago, and subsequently retreated. It is now apparently stationary.

The valleys below the glaciers, being generally covered by moraine material and talus from the hills around, very seldom reveal the solid rock, and consequently the evidence with regard to the erosive action of the ice is insufficient to show whether the glaciers have eroded material in large quantity, or only succeeded in striating and polishing the rocks over which they flowed.

The Reports are illustrated with a large number of plans and photographs. The best thanks of all interested in glacier science are due to Mr. Holland and his staff for the energy with which this important work has been taken up, and the admirable manner in which it has so far been carried out. It is proposed to attack shortly other parts of the Himalaya, including the Kangchenjunga group. It is much to be desired that the example set by the Indian Government may be followed, and that in other parts of the British dominions overseas where glaciers are found, equally systematic observations may be undertaken and carried on by a scientific branch of the local governments.

REVIEWS.

EUROPE.

THE SCOTTISH HIGHLANDS.

'The Geological Structure of the North-West Highlands of Scotland.' By B. N. Peach, John Horne, W. Gunn, C. T. Clough, and I. Hinxman, with Petrological Chapters and Notes by J. J. H. Teall. Edited by Sir A. Geikie. 1907. Mem. Geol. Surv. Great Britain. Pp. vii + 668, pl. lii. With coloured geological map on the scale of 4 miles to the inch.

No publication of the British Geological Survey has been so eagerly awaited as the long-promised memoir on the north-western Highlands of Scotland. That country is built of rocks belonging to four groups, which in a traverse from west to east are exposed in the following order: The Lewisian gneiss of the Hebrides and of the western coasts of Sutherland and Ross; the Torridonian, a thick series of sandstones once identified as Old Red Sandstone; a narrow belt, 100 miles in length, of fossiliferous quartzites, shales, and limestones; and, finally on the east, the western edge of the gneisses and schists which form the main bulk of the Scottish Highlands.

The relation of these four rock series to one another has been the most vexed question in British geology. According to Sir Roderick Murchison, the four groups of rocks had been deposited in regular succession, the easternmost being the uppermost and youngest. Nicol, on the other hand, regarded the eastern and western gneisses as belonging to the same series, and the fossiliferous rocks as having been sandwiched between them by earth-movements. According to Nicol the fossiliferous rocks were the youngest, whereas according to Murchison the eastern gneisses were the youngest. Nicol's view was almost unanimously rejected during his lifetime, but shortly after his death a paper by Prof. Bonney proved that some, at least, of the eastern rocks were the old Lewisian rocks upraised by earth-movements. In 1882-3 the truth of the essential part of Nicol's theory was further demonstrated by Prof. Lapworth's detailed survey of some sections beside Loch Eriboll. He explained how the old eastern gneisses came to be above the younger fossiliferous rocks, as he found that the gneiss had been forced westward, riding over the crumpled masses of the younger beds. Murchison's theory was finally abandoned in 1884, when the results of the first season's work of the Geological Survey in this area were announced by Sir Archibald Geikie. The Geological Survey has now

completed the detailed mapping of the area, and has published maps of two of the most critical localities on the scale of 6 inches to the mile. The work has proved conclusively that the perplexing features in the geology of the area are due to a series of overthrusts. Nicol was therefore right as to the relative ages of the rocks but Murchison was right in the secondary point that the eastern and western gneisses are distinct series. The Survey has shown that the earth-movements are on a very extensive scale; they can be traced from the shore of the Pentland frith for 100 miles southward to the Sleat of Skye, and they have in some places carried the older rocks 10 miles westward over the younger. The conclusions of the Survey were announced in *Nature* by Sir Archibald Geikie in 1884, and a preliminary account of the evidence was published by the Geological Society in 1888; but it has taken another nineteen years for the collection of the complete detailed evidence and its arrangement for publication. It has now been issued in the best illustrated, the cheapest, and probably the most important memoir ever issued by the British Geological Survey. The work gives a full technical description of the geology of this area, but the details are necessary in order to understand the extreme complexity of its tectonic structure.

The book has been written by the surveyors, with the exception of the petrological chapters by Dr. Teall. Dr. Horne, the director of the Geological Survey of Scotland, is the largest contributor to the volume, and his series of introductory chapters lucidly explains both the problems and the general results. The volume has been edited by Sir Archibald Geikie, who initiated the work in 1883, and superintended it till his retirement in 1901, and the text has no doubt benefited greatly by his careful literary revision.

The part of the work of most geographical interest is that dealing with the earth-movements, which are of a type first recognized and described in north-western Scotland, and which have been more thoroughly investigated there than elsewhere. The over-riding of the eastern rocks is illustrated by the elaborate, but clear sections drawn by Mr. Peach. In the most complex part of the area, around Loch Assynt, there are three main thrust-planes, named the Glen Coul, Ben More, and Moine thrust-planes. The evidence for the existence of these three planes of movement, their effect both on the rock masses, and on the rocks beside them, the complex series of minor faults which they occasioned, and the intense changes in the rocks along the planes of movement, are fully described, and illustrated by instructive photographs.

Doubts are still sometimes expressed as to the truth of the overthrust theory, but they are no longer excusable, after the convincing detail of this most important memoir.

J. W. G.

ASIA.

BORDERLANDS OF THE INDIAN EMPIRE.

'The Marches of Hindustan: the Record of a Journey in Thibet, Trans-Himalayan India, Chinese Turkestan, Russian Turkestan, and Persia.' By David Fraser. Edinburgh and London: Blackwood & Sons. 1907. *Map and Illustrations.* Price 21s. net.

Within the covers of this volume, which extends considerably over five hundred pages, materials for three separate books will be found. First, geographical; the traveller's diary kept with the eye and pen of a trained correspondent of newspapers; scenes, scenery, hardships, pleasures, all set forth with much accuracy and no little humour: next, historical and archaeological; for the most part transcription or condensation of what has been published elsewhere, but useful to readers who

know little or nothing of the countries visited: and last, but by far the most important, political and economic. The conflicting interests of England and Russia are examined with shrewdness and impartiality, whilst the possibilities of trade, its development and protection, are considered; and there are remarks about Persia, her resources and proposed railways, which at this moment of apparent trouble, if not revolution, in that land, have a special value and significance.

Seven chapters are devoted to Tibet. They contain an admirable description of the journey from Calcutta by Darjiling and Sikkim to Gantok, Chumbi, and Phari, where the Tashi Lama was met on his return from India. Mr. Fraser wired to the Foreign Office at Calcutta for permission to accompany him and his party to Shigatse, and, this being granted, the country was seen under unusually favourable circumstances. For as the people had dreaded the Indian visit of their beloved Lama, and had mourned for him as dead, so now on seeing him again they rejoiced exceedingly, and thronged to Shigatse to receive his blessing and the protection thus afforded against the spirits of evil. The ceremonies, which are well described, were wound up by a discussion between two monks, one representing Satan, and the other some sacred person.

The return journey was made through a very rough and little-known country, partly west, but mainly south, from Shigatse, skirting Kanchenjanga and among the loftiest peaks in the neighbourhood. The experience gained made Mr. Fraser anxious to see more of the Indian frontiers, so he went to Simla and got permission to cross into Central Asia, whilst, by arrangement with the Chinese Government, he was permitted to visit Chinese Turkistan, respecting which, including the desert of Takla Makan and its sand-buried ruins, so much has recently been written in our *Journal*.

The route followed was by Kúlu, that most attractive valley, through Láhaul and Zanskar, by Leh and the Karakoram pass to Khotan, Yarkand, and Kashgar. Thence Mr. Fraser travelled west by the Terek pass to Kokand, Tashkend, Bokhara, Merv, Mashhad, Teheran, and Baku, where his journey so far as this book is concerned may be said to end. He left Calcutta in January, 1906, and reached London towards the end of January, 1907, so that his interesting adventure lasted a little more than a year.

The historical and archæological parts of the volume need not be closely examined in this notice, whilst political and economic considerations are not usually permitted great prominence in the treatment of matters geographical. Yet they are of all others the most vital, and in this book remarks and deductions respecting the interests of our empire and those of other nations will be found recorded. They are deserving of deep attention, as a glance at the matters touched on will show. For they include such great questions as the defence of India in its most extensive signification from outer attack by arms, or from a more insidious, though to the enemy less dangerous, assault on its trade.

The importance of our exercising permanent influence in Tibet is well set forth. Not merely are the great ranges of the Himalaya our rampart, but Tibet itself, sloping from them to the deserts, is the glacis of our fortification, and a better one could scarcely be conceived. But apart from outside attack, there is the strong sympathy of such states as Nepal, Bhutan, and Sikkim with Tibet, resulting from community of religion, a sympathy which might easily be utilized to our detriment if another nation were supreme in that country. To prevent this, the recent mission under Sir F. Younghusband was undertaken and brought to a successful issue without estranging the goodwill of the great majority of the people and their rulers, only to have nearly every point gained sacrificed.

Again, the effect of railway construction by Russia in Central Asia, on the

north-western frontier of India, is considered. Then as regards Persia, the railway question is examined, and an opinion adverse to construction is expressed. German intervention and the general activity of that enterprising race are not forgotten. These matters are important when attempting to place a just value on the recent Anglo-Russian understanding.

The volume is profusely illustrated, and is well turned out. Misprints are few; among them (p. 252) is the substitution of Bedaulat (unfortunate) for Badaulat (fortunate). There is a map, which serves its purpose, though it cannot be said to contribute much to recent geographical record.

W. BROADFOOT.

INDIAN FRONTIER LIFE.

'Twenty Years on the Indian North-West Frontier.' By G. B. Scott (Survey of India). Allahabad: Pioneer Press. 1906.

Few civilians indeed could lay claim to have taken conspicuous part in so much rough-and-tumble fighting as Mr. G. B. Scott. As a qualified and trained surveyor, possessed of scientific acquirements, he joined the Survey of India Department over forty years ago. He was told off to take his share in the work of the Umbela Campaign in 1863, and since then his capacity for trans-frontier surveying has led to his being attached to most of the military expeditions despatched against the border tribesmen, as well as to his serving in the regular campaigns in Afghanistan in 1878-80. Altogether Mr. Scott must have amassed material enough for a serious work of really exceptional interest. The present book is of modest dimensions, but places on record a number of interesting incidents and episodes connected with the expeditions described. Once the author, hearing firing towards sundown, discovered several tribesmen lining the opposite banks of a stream and firing across at each other. A dispute had arisen as to whether the new moon had been seen or not on the previous evening, which marked the close of the Ramazan fast. Angry words and shots ensued, and eight men were killed and wounded before the point was settled. On another occasion we are told how a bottle of chlorodyne had broken in transit and soaked into the Christmas pudding of a regimental mess. However, an overwhelming vote decided that the pudding should be eaten, which was accordingly done—happily with no disastrous consequences.

With characteristic modesty, Mr. Scott has said nothing about exploits of his own in 1868 and 1878. For the first named he was granted a sword of honour by the Punjab Government; on the second occasion he fought for the whole afternoon against a lot of Mohmauds who attacked him and his party near Fort Michni. Through Mr. Scott's gallantry the tribesmen were beaten off and the little detachment saved. We hope that the success of the present little work may tempt the author to furnish a more exhaustive treatise on the Indian frontier events of the past fifty years—a subject which he is well qualified to handle with knowledge and authority.

WESTERN TIBET.

'A History of Western Tibet: one of the Unknown Empires' By Rev. A. H. Francke, Moravian Missionary. London: S. W. Partridge & Co. *Maps and Illustrations.* Price 2s 6d. net.

This excellent little work has a preface by Mr. Thomas, librarian at the India Office, in which he says, "The English reader may repose every confidence in this interestingly written *History of Western Tibet*, as the outcome, not only of scholarly enterprise and research, but also of familiarity with the country and the people." That is high praise, and so far as we can judge it is deserved. Much information is

collected, gathered from the writings of Megasthenes and Herodotus, from inscriptions and sculptures on rocks, and from local records of those early times to the days when that country ceased to be an independent state, and became, as it still is, part of Kashmir and Jammu. As is fitting, the interest of the book is historical rather than geographical; indeed, from the latter point of view it is defective so far that the vague expression "Western Tibet" is not defined. Probably Ladakh is generally meant, but its boundaries extended into Tibet proper on the east, and included Spiti and Lahaul, if not also Kulu, on the west, all three being now subdivisions of the Kangra district of the Punjab. The two first were undoubtedly Tibetan, whilst Kulu is a Rajput state, inhabited chiefly by Hindus; all these were visited by the pilgrim Hiuen Tsang in the seventh century.

Mr. Francke's researches in folklore are evident in the verses he appends to each chapter; some are very quaint, as is the song of a Mon musician to his fiddle, called "Trashi wanggyal"; others are pretty, as that of the maiden tending flocks to a youth across the valley; and one, at any rate, may be called geographical in that it describes the origin of the world.

"How did the Earth first grow?
At first the Earth grew on a lake.
What grew on the water?
On the water grew a meadow.
What grew on the meadow?
Three hills grew there."

And so on till life is developed.

W. BROADFOOT.

AFRICA.

ACROSS AFRICA FROM EAST TO WEST.

'Across Widest Africa.' An account of the country and people of Eastern, Central and Western Africa, as seen during a twelve months' journey from Djibuti to Cape Verde. By A. Henry Savage Landor. Illustrated by 160 half-tone reproductions of photographs and a map of the route. Two vols. London: Hurst & Blackett, Ltd. 1907. Price 42s. net.

Mr. Savage Landor spent the year 1906 in a journey across Africa from Jibuti to Cape Verde. He travelled rapidly, and, with unimportant exceptions, followed routes already known. Nevertheless, his book has a certain amount of information of value to the cartographer. For instance, on several occasions the author found that the sites of native towns in the Ubangi region had been shifted since the time of the Marchand expedition. It is only, however, with respect to the Lake Chad region that any attempt is made to deal in detail with geographical problems. Mr. Landor crossed the south-eastern part of the lake in a small steamboat, and for about a fortnight skirted its eastern and northern shores—traversing part of the dry bed of the lake. He gives a sketch-map and chart "from latest surveys by French officers and A. Henry Landor," but it is evident that his information is based mainly on the recent labours of French officers. He makes no mention of the prolonged and careful surveys by Lieut. Boyd Alexander and Mr. P. A. Talbot, but observes that "of late years a few French and German travellers have done magnificent work in that region. Among them may be mentioned Barth, Overweg, Nachtigal, Colonel Monteil, Messieurs Foureau-Lamy," etc. Mr. Landor is better informed when dealing with the countries of the middle Niger and Senegal, having received from the French authorities many details illustrative of the astonishing economic development of their West African colonies.

The author appears to be more interested in ethnography than in any of the other subjects that appeal to African travellers—except, indeed, in his own celerity of movement. His scorn of quinine, his belief that to roast one's self in the tropical sun is the best way to ensure health, his touching faith in castor-oil as an almost infallible cure for all ailments—in short (as is very natural) his achievements and his manner of life in equatorial regions bulk largely in these two portly volumes. But next in interest come the peoples he met, some of whom he had opportunities of studying for three or four weeks, some for a few hours only. But of all alike he has much to say.

When Mr. Landor confines himself to describing what came under his personal observation he is well worth attention. His spelling of place-names is generally in the bad French fashion; his photographs are generally good. The map showing his route, on the scale of 1 : 10,000,000, is extracted from that of the Geographical Society of Paris. The index is faulty, and there is no summary of the contents of the chapters. One merit the books certainly have—they are light to handle.

F. R. C.

THE SOUTH-WESTERN PART OF THE CONGO FREE STATE.

'Im Schatten des Kongostaates.' By Dr. Leo Frobenius. Berlin: Georg Reimer. 1907. Price 14m.

Dr. Leo Frobenius, chief of the German exploring expedition of inner Africa, travelled up the Kasai, the Kwilu, the Lulua, Sankuru, and upper Lomami rivers between the years 1904 and 1906. His work has been expected with considerable interest in ethnological circles; it was known that he had made considerable collections to illustrate the culture of the Bakuba and Baluba peoples, and it was hoped, amongst other things, that he would give us some positive knowledge of the little-known Bakuba speech, the classification of which is still a great puzzle to students of Congoland.

It must, I fear, be admitted that the book under review is somewhat of a disappointment.

In the first place, the publishers have gone far to spoil its chances of success in English circles by reverting to the intolerable German type, instead of using Roman letters. The reviewer has had occasion of late to read a great many German books dealing with Africa, more especially African languages, or to subscribe to German reviews of the same purport, and has become so used to all this excellent scientific material being presented in Roman type that he feels indignant any man of science of the standing of Dr. Frobenius should have allowed his important study of South-West Congoland to be printed in the old-fashioned German type. German at its best is not an easy language to read, but it is fifty times more difficult when written or printed in the old black-letter characters.

Except for this fault of type, and the absence of an index, the book is well got up. Many of the photographs are admirable. As to the drawings and the black-and-white reproductions of paintings by Herr Lemme, one's feelings are rather divided. Some of these studies are beautiful works of art, such as the two drawings on pp. 57 and 59 of pineapples growing wild. But they and similar studies are quite unnecessary from a scientific point of view, as the pineapple is not a native of Africa. Some of the sketches of river and other landscapes are clever, but not particularly faithful to actuality, or convincing to those who know anything about Central Africa. For instance, in a sketch supposed to illustrate the Congo at Boma, the artist inserts two Giant cranes of a purely South African species, entirely foreign to the Congo region. Other of Herr Lemme's drawings of trees remind one of studies by Leader, but they might just as well be magnificent clumps of Scotch

pinus as any African tree, just as his rough sketches of natives resemble rapid studies from the nude of Italian old masters rather than characteristic portraits of negroes. Some of his drawings, however, of the parasitic fig-trees are not only beautiful studies, but very accurate. The comic pictures, however, whether by Herr Lemme or anybody else, on pp. 289 and 295, are quite out of place in a work of serious pretensions. With all these criticisms, however, the general effect of Herr Lemme's drawings is very striking, and certainly helps the untravelled reader to get a general idea of Congo scenery. There is an admirable study of elephants opposite p. 412.

In the beginning of the book, Frobenius gives some remarkable photographs of early Portuguese inscriptions on the rock-surfaces of Matadi, which were certainly not previously known to the writer of this review. He does not, however, in his text explain exactly where these inscriptions were situated, or what deductions there are as to their history and age. As his book is—*mirabile dictu*!—without an index, it is possible that the reviewer has overlooked the references in the text to these old Portuguese inscriptions. The photographs are clear and interesting, and the matter should certainly be studied in connection with the history of the Congo. Apparently the inscriptions were discovered by a Swedish missionary named Domenjot.

The author contributes interesting information regarding that mysterious people the Bakuba, but does not throw any light on their peculiar Bantu dialect. The Bakuba, like some of the Baluba and the Bakioke, are obviously tinged with ancient Hamitic blood, no doubt from the same sources as the Hamitic aristocracies of western Uganda and north-western German East Africa. Some studies of Kioko women's faces by Herr Lemme are singularly Egyptian in appearance. Dr. Frobenius contributes much new information about the imperious raiding Kioko or Kioko people of Luba Land. There is a photograph on p. 347 (to which I can find no reference in the text) showing that the sleeping sickness has extended far into the basin of the Kasai and the Lulua. There is also much information, well illustrated, as to the different types of native houses, and there are notes and illustrations concerning breeds of the domestic goat and dog which are of importance. The maps in the text are almost innumerable, and some are of great interest from the remarks on the rocks and geological formation of south-west Congoland.

The book is one which should be firstly reprinted in the Roman character, and secondly translated into English. But the English edition must emphatically be provided with an index. In such a rendering the spelling of the native names should be revised. Dr. Frobenius' orthography is worthy of the middle nineteenth century in its unnecessary doubled consonants, its *tsch*'s and *dsch*'s. For instance, Boma, the capital of the Congo Independent State, is persistently spelt "Bomma." Why? The native pronunciation is Mboma, and the European rendering Boma—both rhyming with Roma. Why, then, spell it "Bomma"?

H. H. JOHNSTON.

AMERICA.

NEWFOUNDLAND.

'Newfoundland and its Untrodden Ways.' By J. A. Millais, F.Z.S. *With Illustrations by the author.* Longmans, Green, & Co. Price 21s. net.

Mr. Millais has made four visits to England's oldest colony, and of those visits this book is the outcome. The author describes his volume as a "hunter's book," and it is safe to say that no one who has made or who contemplates a journey in Newfoundland after woodland caribou will disagree with that definition.

Of the four separate trips which together make up Mr. Millais' knowledge of

Newfoundland, the two most important were those last undertaken and commenced from the south coast, for they led him through a country that to a great extent is patrolled only by the Micmac Indians, whose hunting-ground it forms. The credit of the original inception of the idea of following the caribou into the centre of the island, instead of shooting them as they cross the railway line upon their autumn migration, belongs to Mr. F. C. Selous, who in 1900 went in from 'Terra Nova' and packed from the head of George's pond to John's pond. Mr. Selous' book, 'Recent Hunting Trips in North America,' in which *inter alia* he describes the incidents of his travels in Newfoundland, is probably the most valuable contribution to the literature of big-game shooting published in recent years; but whereas Mr. Selous' work deals almost exclusively with his experiences after caribou, that of Mr. Millais is of larger scope, and includes an exceedingly interesting chapter upon the Micmac Indians (some of whom accompanied him upon his two south coast journeys), as well as a chapter upon the island whale fishery.

There can be little doubt in the mind of the reader that during the author's first trip in Newfoundland, the fascination of the island laid its spell upon him. Realizing how comparatively little was known of the interior, he in subsequent journeys travelled up the Gander river, crossed the island from the south coast to the line at Glenwood, and finally penetrated the country in the neighbourhood of Mount Silvester. These journeys, of which accounts have already appeared in the *Journal*, were performed mostly in canoes, by means of which it is possible to travel very extensively through the waterways of linked lakes and streams. But some long portages were necessary, especially near the headwaters of the Gander.

The narrative in which the author describes his wanderings is always interesting, more particularly the parts of it which tell of his deer-stalking experiences, both in the thick timber and upon ground as open as that of a Scottish deer-forest.

But the most valuable chapters in the book are those in which Mr. Millais deals with the habits and natural history of the caribou. Both by natural tastes and by preparation Mr. Millais is a field naturalist of great attainments, and his observations are always interesting. These facts, added to his skill in illustration, give him a place apart from any of his contemporaries. The illustrations are indeed admirable, and the author shows much ingenuity in avoiding too many representations of caribou; if indeed it is possible to have too many sketches such as grace pages 80 and 81.

H. P.

AN ABORTIVE ENTERPRISE IN BRAZIL.

Recollections of an Ill-fated Expedition to the Headwaters of the Madeira River in Brazil.' By Neville B. Craig, in co-operation with the members of the Madeira and Mamoré Association of Philadelphia. Philadelphia and London J. B. Lippincott Company 1907 Price 18s. net

The failure of the attempt to build a railway from Santo Antonio, at the foot of the Madeira cataracts, to the navigable waters of the Beni and Mamoré has always been a source of deep regret to those who have at heart the development of the great resources of Central South America.

It was in October, 1877, that Messrs. P. & T. Collins obtained from Colonel Church the contract to construct the railway, and on January 2 ensuing the *Mercedita* sailed from Philadelphia with the first contingent for the field of action, from which previous workers had been driven by the ever-present malaria fever. It is this enterprise that forms the subject of Mr. Craig's chronicle, a record of admirable courage and perseverance, combined with a light-hearted indifference about the most obvious precautions, that contributed in no small degree to the

misfortunes which followed in quick succession. The wholly unnecessary discomforts of the voyage of the *Mercedita*, so amusingly described by the author, are typical of all the troubles that came afterwards. There can be little doubt, however, that, had funds been available, the railway would have been built in spite of every obstacle.

The couple of hundred miles of the Rio Madeira that form the background of the story have an evil reputation, which is difficult to realize on the spot as the wonderful panorama of smooth, broad river and luxuriant forest, with intervening tracts of rocks and tumbling waters, passes before one's eyes. Much of the illness has always been of a preventable character, and with our present knowledge of malaria and the methods of dealing with it there should be no difficulty in constructing the line, which, under a contract with the Brazilian Government, has now been once more commenced.

Mr. Craig has some difficulty in understanding how malaria can exist in a region where there are usually no human inhabitants to act as intermediate hosts to the germs. The difficulty disappears if the local belief that monkeys suffer from the disease be well founded, and it is possible that other animals are also susceptible.

When in 1879 the courts decided that the enterprise must be abandoned, the workmen, already weakened by disease, were left destitute of funds and resources, far from civilization, in the heart of the continent, and in their pitiful efforts to return home still further additions were made to the long death-roll of the expedition. Ultimately those who remained were brought home by the contractors.

Out of 719 persons, mainly Americans and Italians, who arrived at Santo Antonio, some 140 are known to have lost their lives, and this does not include all of those who died on their way back, or the eighty who were drowned in the ill-fated *Metropolis* on their outward journey. One would have liked to have heard more of the seventy-five who perished in an attempt to reach Bolivia overland; what route they took, and how they met their death.

The book is well illustrated with photographs and maps.

J. W. EVANS.

LAKES POOPO AND TITICACA.

'Les Lacs des hauts Plateaux de l'Amérique du Sud.' By Dr. M. Neveu-Lemaire. Paris: Imprimerie Nationale, Librairie H. Le Soudier. 1906. Price 7 fr. 50.

The author was one of the *personnel* of the "Mission française" that recently carried out a topographical and geological survey of a portion of Bolivia. He spent the greater parts of the months of June, July, and August, 1903, in the study of the two great lakes of the Bolivian tableland. The specimens collected were subsequently examined in Paris.

Little attention had previously been paid to Lake Poopo, though it presents features of great interest. It is extremely shallow, for, though it has a length of 55 miles and a breadth of 25 miles, only a small portion is more than 4 feet deep, and 13 feet was the greatest depth observed. It is, therefore, a mere film of water covering the lower portion of the plain. It has no outlet, and its level is slowly sinking, so that it may, at no distant date, resemble the South Bolivian lakes that only exist as such in the rainy season. The water contains 2.35 per cent. of solid matter in solution, about two-thirds of that in sea-water. Of this 1.68 per cent consists of sodium chloride, and the remainder mainly of sulphates.

Lake Titicaca is in many ways a complete contrast. The greatest depth observed was 892 feet, and a considerable portion of its basin lies at a lower level than that of Lake Poopo, into which its waters overflow, and whose surface is 400

feet lower. As a result of this outflow the water is comparatively fresh, containing only 0.11 per cent. of solid matter in solution. The salts from the catchment areas of both lakes are therefore accumulating in the basin that lies at the greater height. An interesting feature is the uniform temperature below the surface, almost exactly 11° C. at the time when the observations were made. Alexander Agassiz, on the other hand, who made similar observations in the summer, found a rather higher temperature to prevail—about 12°-5 C.

The sediment dredged from the centre of the lake contained 17 per cent. of organic material, 78 per cent. of inorganic mud almost free from lime, and 5 per cent. of sand. On the other hand, near Chililaya, in the small area separated from the remainder of the lake by the Straits of Tiquina, there was 59 per cent. of calcareous, and 18 per cent. of non-calcareous mud, 12 per cent. of organic matter, and 16 per cent. of sand. Under the microscope small coal-like grains, sponge spicules, diatoms, and material of volcanic origin were observed. Near the north-east shore, in the neighbourhood of Huaicho, the lake-bottom consists of fine sand, including rounded quartz grains closely similar to those of the Sahara.

The transparency of the water in the centre of the lake was found to be practically the same as that of the Lake of Geneva, while, curiously enough, in the small Chililaya basin it was considerably greater.

It is probable that the lakes were once united, forming a narrow inland sea of considerable area, at a somewhat higher level than that of Lake Titicaca. There is, however, no evidence that its waters ever flowed outwards, as the author suggests, by the way of the Rio de La Paz to the basin of the Amazon.

The fish obtained from the lakes were determined by Dr. Jacques Pellegrin. They belong to two genera—*Orestias* (*Cyprinodontidæ*), peculiar to the Andes, but closely allied to *Empetrichthys* of the desert of Amargosa, on the borders of California and Nevada, and *Trichomycterus* (*Siluridæ*), a Southern American genus found both at high and low levels. They include a new species, *O. Neveni*, Pellegrin. One fish only is found in Lake Poopo, and this is believed to be identical with *Orestias Agassizi*, C. & V., var. *innata*, Pellegrin, of Lake Titicaca.

The author has himself described the fish parasites, while the molluscs are dealt with by Monsieur A. Bavay. The latter include a species, *Paludetrina poopensis*, Bavay, peculiar to Lake Poopo, and *Ancylus Creguii*, Bavay, which does not resemble any previously described South American species. The crustacea, some of which are new, were determined by Monsieur Ed. Chevreux, Dr. Edward A. Birge, and Dr. C. Dwight Marsh. One species of Copepoda, *Boeckella poopensis*, Dwight Marsh, is only found in Lake Poopo; another, *B. occidentalis*, Dwight Marsh, is common to the two lakes.

The book is well illustrated by maps, drawings in black and white and colours, and reproductions from photographs.

In conclusion, it may be noted that there are numerous smaller lakes in the high tablelands of the Andean tract, which are of considerable interest, but are not dealt with in the present paper.

J. W. EVANS.

THE ARGENTINE REPUBLIC.

'Modern Argentina, . . with Notes on Uruguay and Chile.' By W. H. Koebel. London: F. Griffiths. 1907. Pp. xvi and 380. Illustrations. Price 12s 6d net.

When a man attempts to portray the social, economical, commercial, and political conditions of a country so advanced in the scale of the world's nationalities as Argentina in the space of one comparatively small volume (which also includes references to similar conditions in Chile and Uruguay), his work must necessarily

be superficial. The social and political side of Argentine life, the description of Buenos Aires, and general criticisms on the relations between the Englishman and the Argentine in that city, hardly supply anything new for the consideration of the reader, although the author does well to emphasize those facts connected with the gradual evolution of the Argentine nation which are of special interest in days when the integrity of older nationalities seems to be seriously imperilled by a slackness in expressions of loyalty to the flag. He points out that the Britisher in Argentina soon ceases to be British under the influence of a constant environment of servid patriotic feeling, and that this feeling is the real secret of the extraordinary success of that country in absorbing and assimilating other nationalities to its own. The Englishman's pride of race and country disappears in one generation, if not sooner, and he becomes essentially as much an Argentine unit in heart and soul as any Spanish or Italian colonist in the land; in spite of the fact that the Government of the country admits of no foreign influence and is absolutely Argentine. This is, after all, chiefly the result of a wise supervision of educational methods, which insists on the constant recognition of the virtue of patriotism and the duties of citizenship as an integral part of each day's instruction in school. It is the same in Chile. It is in this way that nations are framed and consolidated, and it is the apathetic neglect of such principles that disintegrates a nationality.

The best chapters in the book are those which deal with camp and estancia life. This is the soul of Argentina, and it is well to know how the foundations of fortune are laid by the penniless immigrant who, in the process of building up his own fortune, adds his quota to the wealth and strength of the country of his adoption. The extraordinary development of agriculture is very rightly attributed to the results of Italian colonist labour. In the neighbouring state of Uruguay there are no Italian colonists, and the industries of the country are entirely pastoral. In Argentina, beyond a Boer colony and a colony of very mixed nationality, there are none but Italian settlers, and their success in the field of agriculture has certainly influenced the Gaucho, who not so long ago would never have dreamed of putting his hand to the plough. Argentina could easily absorb ten times the present strength of her agricultural population, and in many ways opens a more attractive field than Canada. It is to prospective emigrants that this book should be specially valuable.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

SUPAN'S PHYSICAL GEOGRAPHY.

'Grundzüge der Physischen Erdkunde.' Alexander Supan. Leipzig. 1908. Pp. 936, 22 pl., 252 figs.

Geography and all geographers are deeply indebted to Dr. Alexander Supan for his editorship of *Petermanns Mitteilungen*; and he has added to that debt by the preparation of his 'Grundzüge,' one of the most complete and up-to-date manuals of physical geography. It is only five years since the issue of the third edition, but a fourth now appears revised and enlarged. It is accompanied by a physical atlas of twenty small coloured maps of the world, which illustrate the chief factors that control climate, the distribution of animals and plants, the distribution of earthquakes, of volcanoes, and movements of elevation and depression, the larger geographical homologies, and the arrangement of the chief terrestrial features. Much new information has been added to the section on biogeography which is of growing importance in geography, as the study of the distribution of extinct animals in such works as those of Lydekker has thrown such valuable light on the former arrangement of land and water on the globe.

The book is divided into six main sections: the first deals with the Earth as a whole and the chief modifications of its surface; the remaining sections deal respectively with the atmosphere, the oceans, the dynamics of the land, the surface of the land, and with biogeography. The work therefore covers the whole range of what is usually included in physical geography, except that there is no account of the races of mankind, and no special topographical descriptions of the physical structure of each continent. The latter omission is no doubt due to the fact that the work deals with the general principles of the science, and not with their local application.

As a text-book of physical geography it is of the highest value, from its completeness, its accuracy, the author's wide acquaintance with recent literature, and his fair and cautious judgments. Each chapter is followed by a list of references which forms a bibliography of recent literature on the subject. These valuable lists would be even more useful if the titles were printed on separate lines instead of in continuous paragraphs.

It is impossible to summarize the contents of such a condensed summary as this work. As an instance of its completeness, reference may be made to the details of borings in coral reefs later than that at Funafuti, and their further proof of the complex and variable nature of the rocks, in the limestone sheets of coral islands. The author accepts the fact that the Funafuti boring proved the existence of coral reefs now more than 1000 feet below sea-level, and also the inference that they there proved the subsidence of that island; but he concludes that there is no one theory of coral islands of general validity. The author expresses his regret that the term "Gulf Stream" has not been abandoned, and gives an interesting summary of recent work on the circulation of the North Atlantic, though here may be remarked an exception from the usual completeness of the geographical references in the omission of note of Mr. H. N. Dickson's important contributions to that subject.

J. W. G.

AMERICAN PHYSICAL GEOGRAPHY.

'Physiography.' R. D. Salisbury. London: 1907. Pp. 770, xxvi. pl., 707 figs.

Price 21s. net

The term "physiography" has been very differently used. One classic German text-book adopts it for the description of rocks and minerals; in this country it is usual to accept it, as proposed by Huxley, for a preliminary elementary introduction to natural science. According to Prof. R. D. Salisbury, "physiography has to do primarily with the surface of the lithosphere, and with the relations of air and water to it. Its field is the zone of contact of air and water with land, and of air with water." Upon this definition, which is popular in America, physiography is synonymous with physical geography, and it is not clear what advantage is gained by the use of the special term. This work may, therefore, be regarded as an advanced text-book of physical geography, for which, in English, there has long been an opening; and it will be warmly welcomed, as it is written by a geologist who has given special attention to physical problems, and is at the same time an experienced author and teacher. The work is a sequel to Prof. Chamberlin and Salisbury's text-book of Geology, to which it serves as a fourth volume.

The structural and geological parts of the subject are the most fully treated, there being a full account of the earth-forms, and of the physical agents which mould them. The work of the atmosphere, of ground-water, of running water, of snow and ice, shore action, volcanic phenomena, and crustal movements, are treated in successive chapters. After a full sketch of the structure and

modifications of the lithosphere, there follow chapters devoted to the work of the atmosphere, and of the ocean in so far as they affect the lithosphere. Each chapter is followed by a statement of exercises, and by references, which naturally are taken mainly from the literature of the United States. The work is magnificently illustrated, and shows the tendency to make more and more use of illustrations in text-books; it consists, including index, of 770 pp., and as it contains 707 figures, many of which occupy a full page, and it has 26 plates, a large proportion of the work is occupied by the figures. The text is accordingly often less detailed than would be at first expected in so large a volume.

Apart from its value as a text-book, it will be of great service from its collection of the leading illustrations supplied by the United States of the phenomena of physical geography. It makes many references to Europe, but its most detailed and instructive information is American. Some of the instances quoted from other countries are sometimes more interesting than precise, such as the statement of fogs costing London one million and three-quarter dollars a day.

The work includes useful descriptions of many incidents of geographical interest that have happened in the United States, such as the earthquakes of Charleston and San Francisco, the storms which devastated Galveston and Louisville, and the uptilting of the area near the Great Lakes. The author deals with many disputed problems, and his opinions will be read with interest. He holds that variations in the amount of carbonic acid in the atmosphere have been the cause of former glaciations, and that fiords are the result of glacial erosion; he accepts Sir John Murray's theory of coral islands, and the limitation of the Gulf Stream to the west of Newfoundland. He appears to set little value on Brückner's thirty-five year weather periods, and does not regard the plasticity of ice as an adequate explanation of the flow of glaciers. We note that the author does not use the word "corrosion" as distinguished from "erosion," a useful difference which we have learnt from America, and which has gained ground steadily in this country, though during recent years it has been to a large extent abandoned in America. Whether we agree with the author or not upon his conclusions on disputed questions, we can always admire the fair and cautious judgments in this valuable comprehensive text-book.

J. W. G.

THE WEATHER AT SEA.

'Notes on Maritime Meteorology' By M. W. Campbell Hepworth. London: G. Philip & Son. 1907. *Charts and Diagrams.* Price 2s 6d. net.

In this useful little volume, Captain Campbell Hepworth has brought together his various papers on marine meteorology. They comprise—Meteorology, a Factor in Naval Warfare; Meteorological Observations at Sea; Weather off South Africa and on the Route from the Cape to Australia, about Australasia, and across the Pacific from Fiji to Hawaii. These papers give evidence of much steady work and careful observation. They cannot fail to be of help and interest to all concerned in the science of meteorology.

It has been abundantly proved that weather is a matter of the greatest importance in naval warfare. We believe that naval officers are fully aware of this fact, and that they give more thought and study to weather conditions than Captain Campbell Hepworth seems to think. At the same time, a perusal of these papers would undoubtedly be of service to all sailors.

Our present knowledge of meteorological laws is so limited, that no methods or

rules for forecasting weather can be advocated as absolutely reliable. Experience shows, unfortunately, that the very best methods are sometimes at fault.

Nine years previous to Captain Campbell Hepworth's paper, we dealt with the storm system on the route between the Cape and Australia; our conclusions, based on the examination of numerous observations taken personally in different sailing ships, were that no one route is better or more reliable than another. The belt of storms shifts up and down in a way not yet understood, although it would appear that the chief controlling influences are the changing barometric areas in Central Asia and the variations of pressure at the south pole. A ship may run the easterly course in 40° one voyage, and have a fine "slant;" in the same parallel, on another voyage, the conditions may be most unsatisfactory.

It is a pity that more sailors do not follow Captain Campbell Hepworth's example, and record their meteorological observations at sea. By so doing they might render incalculable service to a science that has many baffling problems.

D. W. B.

SHORT NOTICES.

Europe.—"Through Great Britain and Ireland with Cromwell." By H. E. Marshall. (London: Jack (*n.d.*). Pp. ix., 141. *Maps and Illustrations*.) This, the first of a series of similar works, is an attractive book for school children. It is not laid down exactly on the lines of historical geography as generally understood, but is rather a combination of history and geographical description. Cromwell's career is detailed, and wherever an important geographical name occurs, a pause is made for description—to paint in words, as it were, the scene of each act in the drama. The result is effective, but so desirous is the author of avoiding features unattractive to his young readers, that he has a tendency to omit perhaps desirable facts—dates, for example.

'Florence and the Cities of Northern Tuscany, with Genoa.' By Edward Hutton. (London: Methuen. 1907. Pp. x., 436. *Map and Illustrations*.) A great part of this book consists of personal meditation and narrative, but there is also plenty of historical and descriptive matter. Such a book is probably most attractive to the reader who has covered the ground, and can compare his views with the author's. In this case he would probably dispense gladly with most of the coloured illustrations; those in monotone are more successful. The map is a sketch in Mr. B. C. Boulter's antique manner, picturesquely suitable.

Asia.—"Indian Jottings." By E. F. Elwin. (London: Murray. 1907. Pp. xi., 314. *Illustrations*.) The sub-title of this book is, 'From Ten Years' Experience in and around Poona City,' and the author, a member of the Society of St. John the Evangelist, Cowley, deals with "the ordinary life and surroundings of the mission worker in India." The book is, in fact, almost entirely a study of native character, written with intimacy and interest.

America.—"Guide to Modern Peru." By A. de Clairmont, Consul of Peru. (Toledo, Ohio. 1907. Pp. 66. *Illustrations*.) In the attempt to inspire the reader with a proper conception of the commercial possibilities of Peru (the chief purpose of this book), the writer's style often resembles that of a patent-medicine advertiser. "There is not a country to compare with it in the world," he says; he might, perhaps, have added to the value of his arguments by giving the other side of the picture.

'Reise in das Moderne Mexico.' By Mietze Diener. (Vienna: Hartleben. 1908 [1907]. Pp. 112. *Map and Illustrations*.) This volume is a "souvenir" of the tenth International Geological Congress held in Mexico City. The journey or series of excursions was comprehensive, extending from Mexico City to the extreme

north of the country ; to Saltillo and the vicinity, and to the south. The book is a fairly illustrated narrative.

Pacific.—‘Maori and Polynesian: Their Origin, History, and Culture.’ By J. Macmillan Brown. (London: Hutchinson. 1907. Pp. xxxi. and 800.) To all who are attracted by the mysteries of an inexact science, ethnography, so far as it is one, must be specially attractive. This book, piecing together as it does, by a series of brilliant inferences from scanty knowledge, the story of the origin of two of the most interesting peoples in the world in this respect, cannot but be read with deep interest, especially as the author has to no great extent had to follow well-trodden tracks.

‘In the Strange South Seas.’ By Beatrice Grimshaw. (London: Hutchinson. 1907. Pp. x. and 381. *Illustrations*.) From this writer an entertaining description of the islands visited (Tahiti, New Zealand, and others) would be expected, and is certainly provided in this book. The photographs, moreover, are particularly good, and give no mean idea, within their limits, of the beauties of the south seas.

General.—‘Guide to the Great Game Animals (Ungulata) in the Department of Zoology, British Museum (Natural History).’ (London: By order of the Trustees of the Museum, 1907. Pp. viii., 93. *Illustrations*.) In this handbook an indication is generally given of the geographical distribution of Genera and species, not only at the present time, but also in many cases in former geological epochs.

‘The Mammoth Hunters.’ By Alfred E. Carey. (London: Greening. 1907. 1p. xii., 306. *Plans and Illustrations*.) This is not specified as a book for boys and girls, but it is very suitable for them. It attracts their attention by the opening story of the discovery of a cave by children, and its subsequent exploration by their elders, and out of this episode is developed, with simple interest, a study of the conditions of the life of men “in the morning of the world,” and other kindred matters.

‘Modern Lithology illustrated and defined.’ By Ernest H. Adye. (Edinburgh: W. & A. K. Johnston. 1907. Pp. 128. *Illustrations*.) This should be a most useful work of reference. The text consists mainly of explanation of the admirable coloured illustrations of various rock textures, executed with great delicacy, and beautifully printed. There are, besides, a short bibliography, glossary and index.

THE MONTHLY RECORD.

EUROPE.

The Scottish Peat-mosses.—A third paper on this subject (*Journal*, vol. 27, p. 84; vol. 30, p. 88), contributed by Mr. F. J. Lewis to the *Transactions of the Royal Society of Edinburgh* (vol. 46, part i., No. 2), embodies the results of further fieldwork during 1906, and is, besides, of special interest as summarizing the conclusions to be drawn from the whole investigation. The field of work in 1906 embraced four areas—the first two in the Highlands, and offering examples of valley and upland deposits respectively; the last two embracing parts of the Outer Hebrides and Shetland islands. Of the Highland valley deposits, those of the Parph, Cape Wrath, showed a general agreement with those examined previously in Inverness-shire, Easter Ross, and Caithness, with the exception that the upper forest bed was wanting in the former. In the Assynt district of Sutherland, the arctic plants at the base of the peat were absent, but the upper forest bed was represented, generally in the form of two zones (*Betula alba* and *Pinus sylvestris*) separated by a layer of peat, as in other Highland districts. The upland deposits

of the Forfarshire Grampians showed three distinct types, varying in the age of the peat, but all showing the upper forest bed, though in some cases its upper tier is replaced by a bed formed almost entirely of *Calluna* stems. The Moor of Rannock showed less regularity, especially in the lower layers, as might be expected in a badly drained area liable to flooding. The double tier of trees in the upper forest bed is hardly noticeable here. Both in the Outer Hebrides and in the Shetlands, a lower arctic bed not seen elsewhere was a marked feature, while, though the upper forest bed of the mainland was entirely wanting, the lower forest bed could generally be distinguished. During the whole investigation Mr. Lewis was able to define nine distinct beds, beginning from a basal ("first") arctic bed, and passing through a lower forest bed; a lower and upper bed of peat separated by a second arctic bed; and two tiers of an upper forest bed separated by peat with arctic plants; to the recent peat at the surface. He discusses the geographical distribution of these several beds, and illustrates it graphically by a couple of sections carried through all the principal areas examined. As already noted, the first or lower arctic bed was found only in the Hebrides and Shetlands, its character being different in the two localities. The lower forest shows a somewhat remarkable distribution, being found in the southern uplands, in the Hebrides and Shetlands, but not in the Highlands. It seems that the path of the Atlantic cyclonic systems must, at the time of its existence, have been different to the present; the existing absence of trees from the Shetlands being due, not to temperature, but to the force of the salt-laden winds. No characteristic arctic plants are found in the lower forest bed, and it may be supposed that while the first arctic bed points to a depression of the present alpine-arctic boundary to an extent of 2000 feet, the lower forest bed represents the return of that boundary to at least its present altitude. The lower peat-bog is widely developed, though tending to thin out from south to north, and showing a variation of type in some low-lying districts. The second arctic bed is represented in every district examined along a line from the southern uplands to the Shetlands, though absent in Skye and the Hebrides. The upper forest bed is found on the mainland from the Wigtownshire lowlands to the valley of the Donard. Some of its special features have already been alluded to. Mr. Lewis attempts to correlate the different beds with successive periods of glaciation, and gives a diagram showing the altitudinal limits of the various zones.

The Origin of the Iron Gate.—Among the results of Jovan Cvijić's investigations, carried on for several years, into the tectonic conditions at the Iron Gate, are the following: The breach made by the Danube, on the frontier between Servia on one side and Hungary and Rumania on the other, is 80 miles long, forming the longest breach-valley in Europe. The breadth of the river at its narrowest spot is only 380 feet, with a depth of indentation reaching to 1000 feet. As its precursor, the Iron Gate had a pre-Miocene valley. The floor of the valley, very broad, much warped and dislocated, is distinctly traceable at a height of 1300 feet above sea-level. During the second Mediterranean stage the sea penetrated into this valley, and it became a strait connecting the Pannonian with the Rumanian-Russian sea. In the Pontic period there occurred a difference of level between the two seas, and the strait became a river. At about 2850 feet above the level of the present Danube, its valley-floor, strewn with great masses of boulders, may be clearly traced. This valley-floor, too, has suffered manifold disturbances. Besides these two old valleys, Cvijić has been able to establish the presence of seven Pliocene and Pleistocene Danubian terraces. Down-stream they gradually disappear, in consequence of the subsidence of the Rumanian basin. Up-stream, on the other hand, they are traceable as far as Belgrade, as also in the valleys of the Isker, issuing

from the Balkans, the Timok, and the Morava, as well as in the valleys of the Rumanian tributaries of the Danube, which burst through the Carpathians. On these terraces the history of the development of the Iron Gate down to the present time may be followed. As far back as the Pontic period, elevations occurred in the region of the Iron Gate. They find expression in two waves, the existence of these "waves of elevation" being deducible from the inverse inclination and dislocation of the terraces. They were the cause to which the cutting of the small V-shaped valley of the present Iron Gate into the broad Pontic valley-floor is to be attributed. That the course of the Danube reached back into pre-Miocene times is a fact confirmed by the conditions found at the breaches at Hainburg and Presburg, on the frontier between Austria and Hungary. The plan of the valley at Orsova is, moreover, connected with the very complicated structure of the Banat mountains. In the Cretaceous period these were subjected to an intensive folding with great over-thrusts, and in the long continental time of the older Tertiary they became almost completely levelled. In the place of the present gorge there then existed a broad valley, the situation of which was indicated by a longitudinal rupture. Before the second Mediterranean stage the subsidence of the great basin took place. During this stage a rise in the sea-level occurred, and the valley grew into the already-mentioned strait. The rushing stream that thence was formed in the Pontic period drained the Pannonian basin. Then ensued a renewed elevation of the land, the old valley-floors became again warped, and the river incised its passage anew. In Pliocene times a subsidence of the basins again occurred. This was perhaps connected with the forcing up of the mountain barriers, a circumstance serving to explain the low terraces.

ASIA.

Dr. Hedin's Explorations.—A letter from Dr. Hedin, printed in *Petermanns Mitteilungen*, No. 1, 1903, supplements previous accounts to some extent, though all the essential points have already been referred to in the *Journal*. It is dated "Gartok, October 7, 1907," and runs as follows: "Here in Gartok I have completed a new section of my journey. It is exactly half a year since I left Shigatse, and many great and important discoveries have been made in the interval. The great range, which I first crossed at the Sela-la, I have now surmounted by four other high passes, and so have been able to trace its course. It is an enormous chain, certainly not inferior in length to the Himalayas, and the mean height of the passes is greater; only in the height of the peaks do the Himalayas of course retain the advantage. From Shigatse I followed generally the Ragha-tsanpo, and went as far as the Targut-gangri and the neighbourhood of the Dangra-yum-tao; to the south of it is a very large lake, the Shuru-tso. From Tradum I crossed the watershed between Tibet and India and paid a short visit to Nepal. Then followed the discovery of the source of the Brahmaputra, which comes from a huge glacier mass, the Kubi-gangri, belonging to the northernmost chain of the Himalayas. The supposition of Nain Singh that the Mariam-la is the origin of the river is entirely wrong, for only one of the smallest tributaries descends from this pass.* Then for five weeks I studied the Satej problem. The real source of this river lies, not where it is marked on maps, but two long days' journey east-south-east of Manasarowar. On the same pass from which the most westerly branch of the

* It may be observed that the stream descending from the Mariam-la has been shown merely as a side-branch on all the best English maps since the journey of Nain Singh in 1865. The latter reported the main branch to be fed by many large glaciers

Brahmaputra flows eastwards, begins the river Tage-tampo, which falls into the Manasarowar, and at my visit discharged 11 cub. metres (389 cub. feet) of water per second; altogether 31 cub. metres (1095 cub. feet) flow into the lake. There is no longer any visible connection between the two lakes, but the water passes underground from Manasarowar into Rakas-tal, and from this again by an underground channel further west, appearing again in the form of innumerable springs in the old Sutlej bed. I have made a very exact bathymetrical map (129 soundings) of the Manasarowar (Tso-mavang). Then I made the pilgrim journey round the Kailas, and, from the temple Diripu, an excursion to the source of the Indus, where, so far as I know, no European has been hitherto. The source is called by the Tibetans Singi-Kabap—that is the mouth, out of which the Indus comes. From here I travelled north-eastwards through unknown country to Yumba-matsu in 32° N. lat., and then back to Gartok, crossing the Indus again. As Ryder and Rawlings had made the journey from Shigatse to Gartok, I tried to avoid their route, and of about 135 days' marches only 2½ lay along it. They accomplished their journey in 72 days, and I in exactly six months, for I made many excursions to the north and south. Maps—as, for instance, that in Stieler's atlas—must now undergo many extensive alterations. Especially remarkable will be a quite new gigantic range right across the whole of Tibet, for the Nin-jeng-tang-la, to the south of the Tengri-nor, is the same chain which I crossed a few days ago to the north of Gartok by the high and difficult pass Jukti-la.* Since leaving Shigatse I have visited twenty-nine gunpas and accumulated hundreds of sketches; most of these temple cloisters were hitherto quite unknown. I have a very ample collection of observations. Reckoning from Shigatse, the map consists of 301 sheets with forty astronomical points, several hundred panoramas, which give a very good representation of the scenery and the general character of the highlands. I have also a series of precise measurements of the volume of water in the Brahmaputra and its tributaries, and an exact series of levels showing the difference between the Manasarowar and Rakas-tal (Langak-tso) equals 44 feet, or 14 metres. . . . Now I am on my way to Ladak. A year and three months in Tibet is enough for any ordinary man, and now another winter is beginning, with the thermometer already at a minimum of -21.3 C., as it was last night. It was not so cold at the same time last year further to the north and at greater elevations; perhaps this is because the rainy season has not put in an appearance."

Journeys in Hunan and Kiangsi.—An article by Captain Harfeld, with plan and illustrations, in the *Bulletin* of the Royal Belgian Geographical Society (vol. 31, Nos. 4 and 5), supplies a comprehensive description of north-west Hunan and west Kiangsi, from the point of view of topography, agriculture, mineral and commercial resources, etc. The first part (pp. 280-311) is devoted to a description of the rivers Siang Kiang and Yuen—their respective courses, tributaries, *régimes*, navigation, and the principal towns on their banks, including a minute account of the capital of Hunan. Thereon follow six itineraries: (1) From Ching Yu Wan and Fu Tai Shan (villages on the left bank of the Siang, 30 miles below Chang-Sha) to Chang Te Fu on the Yuen; (2) from Chang Te Fu to Tsen Chau on the

* The existence of such a range has long been suspected by geographers. Thus it was drawn by Mr. Brian Hodgson as a distinct and continuous chain under the name "Nyenchen-thangla" ('Selections from the Records of the Government of Bengal,' vol. 27, 1857). It was spoken of by Sir Clements Markham ('Bogle and Manning,' p. xxiv) as "the great northern chain of the Himalayas;" while Mr. Trelawny Saunders proposed for it the name "Gangri" (see map in the last-named work, and article in the *Geographical Magazine*, vol. 4, 1877).

Yuen; (3) from Chang Te Fu to Li Chau, a South to north route, which, crossing the Li by a fine stone bridge of eleven arches, enters the prefectorial town of Li Chau with 200,000 inhabitants; (4) from I Yang Hsien to Chang-Sha by Ning Kiang Hsien; (5) Siang Tan to Ngan Yuen (in Kiangsi); (6) from Chu Chau (Central Hunan) to Li Ling (in west Kiangsi). The article concludes with the journal of two journeys: one through west Hunan, made early in 1904; the other through east Hunan, made in the corresponding part of 1903. The mineral riches of north-west Hunan and west Kiangsi are stated to be immense, as testified by the relatively brilliant results of Chinese enterprises in this field in various places. The principal minerals of commercial value include gold (rich veins of auriferous quartz having been exploited at Yu Ka Tsan and Hu Lu Wan, while in other parts there is auriferous sand); argentiferous lead at various places, on the security of which the Carlowitz firm advanced money to the Chinese minister of railways; coal, of which there are numerous and important beds; iron, silver, copper, antimony, and zinc. As already said, there are detailed accounts of the principal towns. Chang-Sa, the capital of Hunan, extends nearly 2 miles along the right bank of the Siang, with a population of from 250,000 to 300,000. The busy part of the city is about 2 miles from the northern port. The place, however, of future importance is the sandy island (giving its name to the capital) I Shui Lu, 2 miles long by 500 feet broad, and 1000 feet distant from Chang-Sa. Below is another smaller island. Chang-Sha has a number of beautiful temples and numerous schools, including sixteen high schools, two military academies, and many private schools. Near the city a sacred hill rises out of a rich and fertile region to a height of over 1300 feet. Chang-Sha has important antimony and iron foundries, and manufactures paper, jewels, art furniture, etc. Its commerce absorbs a third of the foreign imports into Hunan, including cotton thread, plain and printed cottons, grey and white cloths, raw and woven silks, silk embroideries, linens, and furs. It likewise imports beans, pork, fresh and dried fish, rice, wines, German champagne, American corn, tea, cane-sugar, leaf and prepared tobacco, native and foreign opium, pipes, morphine, cheap American cigarettes, Japanese matches; rhubarb, camphor, and other medicinal plants; scents, musk, fashionable cloths, European and Japanese umbrellas, palm leaf and paper fans; gold, silver, and jade jewellery; petroleum from America, Sumatra, and Borneo; German lamps, candles, incense; objects in copper, white metal, and antimony, etc., etc. The revenue of the imperial customs at Chang-Sa rose from 35,000 taels in 1904 to 86,000 taels in 1905.

Cape Dezhnef, or East Cape.—Our honorary corresponding member, Colonel J. de Schokalsky, writes to us urging the general adoption of the name Dezhnef for the cape forming the most easterly point of Siberia, after the Russian seaman who was the real discoverer of Bering strait (1648). Colonel Schokalsky lays stress on the merits of this bold explorer, regretting that his name is less generally known than it deserves to be. It may be pointed out that the proposed adoption of his name for East Cape was referred to in the *Journal* some nine years ago (vol. 12, p. 609), and that it is now commonly found in English maps. The recent Admiralty charts all give the name Dezhnef (Dezhnev) as well as the older appellation. The Russian explorer has been by no means unknown to English readers, as his achievements, so far as traceable, were made known in this country over a century ago, on the one hand through Jeffreys' translation of Muller's account of the Russian discoveries, and in the second through Coxe's work on the same subject.

AFRICA.

The Faro Tributary of the Benue.—This river, the confluence of which with the Benue was reached by Barth in 1851, has never been traced upwards to its source, although its upper course was touched at various points, a good many years ago, by the routes of Flegel. An examination of a portion of the river above the confluence of the Deo (the main western branch) has lately been made by Lieut. Strümpell (*Deutsches Kolonialbl.*, November 15, 1907). For two or three days above the junction this officer navigated the stream in canoes, but rapids then compelled him to take to the land, a way being cut with some difficulty through the uninhabited bush which covers the banks. At the farthest point reached (where the river still had a width of 50 to 100 yards), a view was gained of the plateau escarpment from which the stream descends, and in which its valley seems to form a sort of gulf. The lower country is broken by low hills and intersected by temporary streams. Below the confluence of the Deo the Faro has a wide sandy bed, with a shifting deeper channel, to which most of its water is confined in the dry season. Throughout this section it would be navigable for river-steamers. Above the Deo the river has higher banks, is rapid, and barred by serious obstructions, though some portion might be navigable. The country through which it flows was formerly much better peopled, remains of old settlements being frequently met with; but it has been depopulated by native wars. There are still some settlements of the Woko, who have proved a tractable people, though terrorized by their eastern neighbours, the Namji. Lieut. Strümpell thinks that if these latter were held in check, the country might be re-peopled by the pagan tribes of the region. Traces of elephants, buffalo, and other wild animals were seen, but the upper Faro valley does not abound in game to the extent that has been supposed. Under present conditions, the river above the Deo does not seem to offer great possibilities as a trade route. Of its course on the plateau above the descent of the escarpment, nothing appears to be known.

Vegetation Features of South-West Africa.—Even where the constituent elements of the Africa flora are fairly well known, there remains much to be done in the way of studying their distribution and ecological relations. A useful contribution in this direction has been made, in respect of the arid region of South-West Africa, by Mr. H. H. W. Pearson, who early in 1907 made a journey from Walfish bay to Windhuk, which he describes in the *Kew Bulletin*, 1907, No. 9. Apart from the notes on the vegetation, the paper gives some interesting information on the present economic position in that region. From Walfish bay—which seems to have fallen into a condition of almost complete stagnation since the port of entry into the German territory was transferred to Swakopmund—Mr. Pearson went on foot to Rössing on the Otavi railway, making the rest of the journey, outward and return, either by this or the Windhuk railway. The zone of sand-dunes, varied by mud flats, which is the first to be traversed, is about 7 miles wide at its narrowest. The flats here and there support a luxuriant growth of the Argentine *Nicotiana glauca*, which, according to Baines, was introduced about 1854, and has proved a most successful colonist. It reaches a height of 15 to 20 feet, and, with the native *Tamarix articulata*, supplies the wood used for the framework of the native huts and for fuel. Economically, the most important member of the flora is here the "Naras" (*Acanthosicyos horrida*), a cucurbitaceous plant, which sends down its roots to a great depth beneath the dunes, with the growth of which it keeps pace, its old buried stems, as stout as the human arm, serving in part as water-storers. For about four months in the year its nutritious seeds and the juicy flesh of its fruit form the chief food of the Hottentots.

At their eastern limit the dunes show no marked diminution in height, but are suddenly replaced by a gentle slope of ripple-marked sand leading up to the "Namib," a hard and stony plain rising eastwards to a height of about 2000 feet. There are many extensive areas on it where the plant-population is not more dense than three or four individuals to the acre. Towards the west there is an abundance of rounded, water-worn pebbles, and there is evidence in support of the view that the maritime belt has risen during recent times. The remarkable number of dry river-beds seem relics of a period of much greater rainfall, and the deeply eroded cañons of the Swakop and the Khan point to a similar conclusion. On the plateau the most characteristic plant is the curious fleshy-leaved *Zygophyllum Stapfi*, *Welwitschia* occurring more locally, while the main river-beds possess a much more abundant and less severely xerophytic flora. It seems doubtful whether the additional elements found here are due to the transport of seeds from the upper basins of the rivers, or whether the flora is a relic of one which spread all over the "Namib" when climatic conditions were more favourable, and of which only such species have maintained themselves on the plateau as could adapt themselves to the altered environment. Mr. Pearson inclines to the latter view. The soil temperatures obtained in the Namib on January 29-31 varied from 73°·6 Fahr. at 6 a.m. to 129°·2 at 2.45 p.m. At night, as is well known, this zone is remarkable for its fogs. Mr. Pearson found that seeds of *Welwitschia* which had been lying on the ground for six months exposed to the above fluctuations germinated within a fortnight under laboratory conditions. He considers that this region would be especially favourable for the establishment of a botanical laboratory for observations on desert life. There is a transition zone from the Namib to that of the "Acacia park forest," which extends to Windhuk, and includes some good grazing areas. On the plateau to the east of Windhuk the trees again become fewer and the undergrowth less abundant.

AMERICA.

The Currents in Belle Isle Strait.—The importance of this strait as lying on the most direct route from England to Montreal and Quebec, and its constantly increasing use by shipping, renders an accurate knowledge of the *régime* of its currents a matter of great moment. For a long time the erroneous belief prevailed that the current in the strait maintained a constant direction inwards, and this through its tidal character had been definitely ascertained, by Mr. M. H. Warren, in 1854. In 1894 a survey was carried out by the Marine Department of Canada, which once more established the true character of the currents in general outline (cf. *Journal*, vol. 8, p. 72).* A still more careful survey was made in 1906, in which year the whole season, from June 7 to September 22, was devoted to the strait, the most modern methods being employed in the investigation of the currents. The results have been put forward by Dr. Bell Dawson, the engineer in charge, in a special report issued by the Department of Marine and Fisheries (Ottawa, 1907). As was already demonstrated in 1894, the current in the strait is fundamentally of a tidal character, all the variations in the tide being represented by similar variations in the current, though this is complicated by a tendency to greater flow one way than the other. Thus, a berg may drift up and down with the flood and ebb, but in the course of a day will make on the whole a

* Reference is made, in the report now under review, to various journals in which attention was called to the results of the survey of 1894, the *Geographical Journal* not being among the number. It may be pointed out that those results were clearly stated in the volume above quoted, on the authority of the 'Report of the Survey of Tides and Currents,' etc., for 1895.

considerable gain in one direction, the average rate at which this gain is made sometimes amounting to over one knot per hour. But this greater flow may be either inwards or outwards, though during the whole of the observations there was almost always some dominant flow, which continued in one direction for periods varying from two or three days to two weeks and more at a time. It is this element of the current which brings the icebergs into the strait, or keeps it clear, as the case may be, and it is of much interest to discover the probable cause. Dr. Dawson examines in turn the various factors, astronomical and meteorological, which might be responsible for the phenomenon, and finds that there is no evidence of any true period of an astronomical character that can be assigned to the dominant flow; that it cannot be explained as a wind drift, though examples of such a drift have been met with in the strait; but that the cause is apparently related to general weather conditions acting indirectly. Thus difference of barometric pressure may occasion a change in the volume of the Gulf of St. Lawrence, through Cabot strait, which may react on the flow in Belle Isle strait; or more probably the effect may result from some fluctuation in the Labrador current, itself due to meteorological causes. Dr. Dawson suggests some practical indications of the probable direction of dominant flow at any given time.

The Nakimu Caves, British Columbia.—The report of Mr. A. O. Wheeler, Surveyor-General of Canada, for the year ending June 30, 1906, includes a detailed account of the Nakimu caves, highly interesting at once from a picturesque and a scientific point of view, recently discovered in the Selkirk mountains. The caves lie in Glacier Park Reserve, in the bed of Cougar Creek that has hollowed them out, and of the present channel of which they form part, 6 miles from Glacier house, the Canadian Pacific Railway hotel near the summit of Rogers pass. From Glacier house a bridle trail, 3·8 miles long, now leads to Cougar Water-tank, whence a bridle path of nearly 2 miles, now in course of construction, will, when finished, lead to the camp ground at the caves. The caves were first brought to public notice in 1904 by Mr. C. H. Deutschman. In 1905, twelve persons, including an underground engineer, visited the caves. In 1906, Mr. Wheeler made three visits—the first, preliminary; the second, for the purpose of surveying the entire valley and the enclosing peaks and locating the caves, so far as then known, above and below ground; the third, with a view to surveying the third and largest series of caves discovered two months previously by C. H. Deutschman. The caves comprise a labyrinth of passages cut through a ridge of dark blue limestone. At intervals the passages open into curious circular pot-holes, descending one to the other in a succession of steps. Into cavernous openings and deep abysses subterranean waterfalls leap with thunderous roar, intensifying the eeriness of the pitch-black depths glimmering under feeble lantern rays. Overhead project fantastically shaped spurs of rock. The visitor enters marble halls, with walls and ceilings frescoed in flowery designs of snowy whiteness, evoked into momentary vision by a flash-light. Throughout, the floors are of broken rock, seamed by cracks; in many places accessible only to skilled climbers. Outside the scene is almost equally weird, as the stream disappears and re-emerges at some depth below in a swirl of foaming cascades. A little more than a mile above the tank the exit of the underground flow from the caves is seen; higher up the volume of the stream is much shrunk. One-third of a mile above the outflow is the "wind crack," whence issues a shaft of cold wind. The report includes detailed accounts of the discovery, and a description of the valley of the caves, as well as of the individual caves with their formation and structure; also a topographical map of the Cougar valley, on a scale of 1: 15,000, and a map of the cave system on a scale of 100 feet to an inch.

AUSTRALASIA AND PACIFIC ISLANDS.

Scientific Research in the Pacific.—It is announced in the *Pacific Commercial Advertiser* (Honolulu, December 14, 1907), that a body known as the Pacific Scientific Institution has been successfully organized, with a view to undertaking a complete scientific exploration of the Pacific ocean and its many islands. While the chief energies of the institution will be devoted to ethnology, the geology and configuration of the region will also be investigated, and studies in zoology and botany will be carried out, as also of winds and ocean currents with a view to throwing light on the distribution of animals, plants, and of the human race. Expeditions are to be despatched in a specially equipped vessel, and it is anticipated that fifteen years may be needed for the work. The moving spirit in the organization of the project is said to be Mr. W. A. Bryan.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Stereoscopic Colouring of Maps.—With reference to our note on this subject in the *Journal* for June, 1907, p. 680, Herr G. Freytag, of the Vienna cartographical firm of Freytag & Beradt, writes pointing out that the system of showing relief by means of a special arrangement of outstanding and retreating colours, has for some time been adopted in the publications of that firm, particularly in those intended for educational purposes. In addition to the use of this definite colour-scale, much has been done to improve the representation of *form* by a suitable distribution of light and shade.

Mountain-building in Miniature: Origin of Transverse Valleys.—The problem of the origin of valleys cutting transversely through mountain ranges has given rise to much discussion, the most commonly accepted explanations being either that the erosive action of running water has kept pace with the slow elevation of the range, or that the transverse valley has been formed by the backward-cutting of a stream which originally descended the outer slope. In the *Geographische Zeitschrift* for November, 1907, Dr. S. Passarge calls attention to an interesting case of mountain-building in miniature, which he thinks may throw light on the origin of some transverse valleys. A railway embankment thrown up near the station at Lychen (North Brandenburg) rested on the flank of a mass of diluvial sand, etc., at the spot where it dipped beneath an old lake-bed forming a level expanse of alluvium topped by a layer of turfy soil 3-5 feet in thickness. The pressure exerted by the embankment ridged up this turfy layer into a series of folds, the innermost and highest of which reached a height of 5 or 6 feet, while they died away outwards in a series of concentric rings, not continuous, but, as might naturally be expected, taking the form of a series of short overlapping arcs, highest in the centre and sinking towards the extremities so as to leave a series of depressions uniting the longitudinal furrows. But the most interesting point was the fact that these arcs had been frequently torn asunder transversely just at their highest point, giving rise to a series of fissures which closely reproduced the transverse valleys of many ranges. The whole formation offered a striking parallel to that of the Swiss Jura. This occurred in 1900, and the ridges have since lost much of their original sharpness, but a recent visit showed that the transverse fissures had been well maintained, and even, it seemed, accentuated. Without denying that the usual explanations may often hold good, Dr. Passarge thinks that this may sometimes at least have been the mode of origin of transverse valleys.

Lateral Erosion of Streams.—Prof. Mark Jefferson has lately paid some attention to the question of lateral erosion by streams, and has endeavoured to

ascertain in certain definite cases whether the process must be attributed to terrestrial rotation or to some other cause. The rivers examined are in the lower peninsula of Michigan, a drift-covered area out of which the rivers have carved winding valleys between grassy bluffs, while they themselves follow courses yet more winding on the floor of the flood-plain. Here and there the bluffs form "scars" or steep slopes of naked clay, these occurring at points where the meandering stream is now close to the valley wall. In 1903 Prof. Jefferson examined the scars on the lower Rouge river in company with Mr. I. Bowman, with a view to ascertaining what proportion of the valley was now subject to the widening process. It proved to be ten per cent., but Mr. Bowman noticed that for many miles two-thirds of the scars occurred on the right bank, and he suggested terrestrial rotation as the cause. To test this theory Prof. Jefferson has since undertaken the examination of other streams flowing in other directions, and the results have been presented to the Geological Society of America (*Bulletin*, vol. 18, 1907, pp. 333-350). It was found that most of the streams show persistent and uniform tendencies towards one or other side of their valleys wherever there is a flood-plain on which the streams meander between distinct bluffs. But though several bear strongly to the right, one at least bears as strongly to the left, whereas, if terrestrial rotation were the cause, the tendency of all should be towards the right. Prof. Jefferson is inclined to account for the tendency by the general tilting of the region towards South 27° W., which has been described by Gilbert.

HISTORICAL GEOGRAPHY.

A Historico-Geographical Document of the Fourteenth Century.—Mr. C. R. Beazley has done good service by printing in the *American Historical Review* (vol. 12, No. 4, and vol. 13, No. 1, July and October, 1907) an early document of much interest, which has hitherto received far less attention than it deserves. Apart from extracts printed in 1719 by Quétif in the '*Scriptores Ordinis Prædicatorum*,' through which it was known to Sir Henry Yule ('*Cathay and the Way Thither*,' vol. 1, pp. 191-192), it has so far remained in manuscript, and though one copy is to be found in the library of Magdalen College, Oxford, it has been almost entirely disregarded by students. Under the title '*Directorium ad faciendum Passagium Transmarinum*,' it consists of a memorial addressed about 1330 to King Philip VI. of France in the hope of stimulating a revival of the crusading energies of Western Europe, primarily against the Eastern Church, but also against the Moslems and other Eastern powers, the aim and ambition of the writer being the reduction of the whole of the Orient under Catholic rule. The name of the author remains unknown, though the work has been attributed to John de Cora, appointed Archbishop of Sultaniyah, in Northern Persia, in 1330, and the author of a '*Livre de l'Estat du Grant Caan*.' But, as Mr. Beazley shows with much force, this identification is vetoed, not only by discrepancies as to actual facts, but by the entirely different mental attitude of the two writers, the author of the '*Directorium*' being characterized by furious bigotry in regard to men of other faiths, of which no trace is to be found in the work of John de Cora. He had evidently been engaged in missionary work in Persia, besides making himself acquainted with Socotra, and his knowledge of the then existing conditions in the Eastern states, and their relations with the West and with each other, gives his work a decided interest from the geographical, as well as from the historical, point of view. Mr. Beazley has edited the text with great care, and while following to the letter what seems to be on the whole the most satisfactory manuscript (that of Paris), he has given in footnotes every divergent reading in the Magdalen copy, apart from mere differences of orthography. He has also supplied an interesting account of the work as a whole,

besides giving a brief analysis of its more important contents. Besides a general discussion of the motives for undertaking the crusade, in which the religious and general condition of the nations of Western Europe and Eastern Asia is fully entered into, there are sections on methods of action (including a scheme of siege operations against Constantinople), on the possible routes to be followed, and on the policy to be adopted in the governance of the conquered peoples. Among the more special objects of conquest was the empire of "Rassia," by which is to be understood, as Mr. Beazley points out, not the modern Russia, but the Servian empire of the fourteenth century which occupied nearly all the north-west of the Balkan peninsula. The work shows many analogies with the 'Secreta Fidelium Crucis' of Marino Sanuto the elder, and like this writer the author would absolutely interdict all maritime trade between Latin Christendom and the Moslem countries.

GENERAL.

The Royal Scottish Geographical Society.—We are pleased to learn that an annual grant of £200 towards the objects of this Society was sanctioned by the Treasury early in February. This should prove of material assistance towards the continuance and extension of the useful work accomplished by the Scottish Society since its foundation.

A New British Geographical Society.—We learn with much interest that active steps are being taken to establish a new provincial Society for the furtherance of geographical aims, under the title "The Leeds and Yorkshire Geographical Society." The promoters are Leeds public men, connected for the most part with the "Leeds Institute," and the meetings will be held in that city. A committee has been formed, and has already had under consideration the objects and constitution of the new body, which will include in its activities the arrangement of lectures, excursions and exhibitions, the publication of a journal, and the formation of a library. We understand that Lord Faber will probably be first President, while among the vice-presidents will be Mr. E. R. Wethey, of Bradford, whose services to geographical education in Yorkshire are well known. The stimulation of a local interest in geography is a work of much importance, towards which less has perhaps been done in this country than elsewhere, although local research must take a more and more prominent place in the geographical work of the future. We may anticipate valuable results from the new undertaking.

Lectureship in Geography at the University, Sheffield.—Through the liberality of Mr. Edgar Allen, of Sheffield, a Lectureship in Geography has been founded at the university of that city. Mr. Allen has already presented the university with a new library, which is in course of construction. The salary of the lectureship is £300. As will be seen from an advertisement in the current number of the *Journal*, applications are invited for the new post thus created. It is very significant of the rapid progress which has recently been made in the recognition of the importance of geography as an educational subject, that a lectureship should have been founded in so important a manufacturing and commercial centre as Sheffield. It may be useful to recall the fact that geography now forms a regular part of the curriculum at the universities of Oxford, Cambridge, London, Manchester, Liverpool, Birmingham, Sheffield, Aberystwith, and Edinburgh, and there is reason to believe that other universities will, ere very long, follow suit. There is thus considerable encouragement for really competent men to devote themselves to geography as a profession.

The Spelling of Place-names.—At the instance of Prof. Ricchieri, of the Accademia Scientifico-Letteraria, Milan, the reader of a paper on this subject at the No. III MARCH, 1908.]

Sixth International Geographical Congress, held at London in 1895, the organizing committee of the Ninth International Geographical Congress, which is to meet at Geneva on July 27 of this year, has placed on the agenda of the congress the following question: What are the principal difficulties in the way of arriving at an international agreement on the transcription and orthography of geographical names, and in what manner can they be surmounted? Prof. Ricchieri, believing that if this problem is to be solved at all it can only be by slow stages and methodical procedure, proposes that all that should be aimed at in the first instance should be a preliminary agreement among a few men of different nationalities interested in this question as to the fundamental points on which it is necessary that an agreement should if possible be reached, and that a statement of those points should be laid before the Congress at Geneva, which should then be asked to appoint a small committee to study and procure the discussion of those points, and ultimately to draw up proposals and resolutions thereon. He further suggests that this committee should be expected to publish its proposals at least one year before the meeting of the next International Geographical Congress, which, it is hoped, might then be in a position to draw up final resolutions on the subject. This scheme of operations has received the support of Prof. Henri Corlier, of the *École Spéciale des langues orientales*, Paris; Prof. Robert Sieger, of the University of Graz; and Mr. G. G. Chisholm, Recognized Teacher of the University of London (Birkbeck College), who have agreed to co-operate with Prof. Ricchieri in drawing up the preliminary statement of fundamental points requiring solution to be laid before the Geneva Congress. If any Fellows of the Society have any suggestions on this question to make, and will kindly communicate them to Mr. Chisholm at his private address (59, Drakefield Road, Upper Tooting, S.W.), he will be glad to forward them to Prof. Ricchieri.

"On North Polar Problems"—Erratum.—In Mr. Harris's letter on this subject in the February number of the *Journal*, p. 227, line 10, "0.5 foot" should read "0.2 foot."

OBITUARY.

General Sir Richard Strachey, G.C.S.I., F.R.S., LL.D.

AMONGST the names of those who have occupied the distinguished position of President of the Royal Geographical Society it may be doubted whether one could be selected with greater claim to the honour of lasting recognition by the scientific world than that of General Strachey. It is well said of him that in variety of his claims to distinction he may be regarded as "the most remarkable of the Stracheys, who for four generations and over a period of more than a century and a half have given to India the best portion of their lives;" for it is India that owes to Richard Strachey the deepest debt for his splendid achievements in the executive branches of her public works, as it owes to his equally distinguished brother John the development of much of her system of civil administration and finance. There was a time, indeed, when the Government of India was sarcastically called the "Government of the Stracheys," and this, too, when India was ruled by one of the ablest and most popular of her viceroys. For seventy years, commencing in the reign of William IV., was Richard Strachey a living force in India as practical engineer and scientific adviser, and it seems probable that such a record is unequalled in the annals of that country.

Born in 1817, he entered Addiscombe, the military school of the East India Company, in 1834; and after the usual two years' course of training, left as head of his term, and joined the cadre of that truly remarkable body of men whose names are equally distinguished in the military and civil history of India—John Company's engineers. There were opportunities then for men of the Strachey stamp. It was close on the period of India's awakening from a dreamy participation in oriental methods to a realization of her destiny as a great living factor in European politics and the necessity for adopting the main principles of economic development on the strenuous lines of the West.

From the very beginning Richard Strachey took up the white man's burden with the energy and confidence of a born leader, and whether he applied his high scientific ability to the training of waterways and irrigation through the dry spaces of upper India, working as a navvy in his shirt-sleeves, or whether, having donned the uniform of a soldier, he assisted with military plans and bridges to the conquest of the Sikhs, his whole heart was in his work. But the practical hand was always guided by the scientific brain, and it is hard to say whether as military engineer and Indian councillor, or as scientific investigator, he won the greatest fame. In the domains of botany, meteorology, geology, and physical geography he was equally at home as an original investigator, and his claims to distinction were fully recognized by the Royal Society, who conferred on him their medal, and elected him to be a Vice-President in company with such men as Spottiswood, Hooker, Huxley, and Kelvin.

As President and Councillor of the Royal Geographical Society we many of us remember him—the keen, determined face and the instant decision. There was no “uncertain sound” about Sir Richard Strachey's opinions, whether he fought the battle of the gauges of India (probably the only losing battle he ever did fight) or whether he laid down the rules on which scientific geography should be taught in England, he was equally clear in his views; and it is to him chiefly that we owe the change which has been effected in those methods of geographical instruction which have already borne such remarkable fruit. He was not over-anxious to publish his own records of geographical exploration to the world, instructive as they were. Knowledge and not advertisement was the objective of his enterprise, and so it was quite late in life, and under rather special circumstances, that he contributed the narrative of his journey to Lakes Manasarowar and Rakas Tal in Western Tibet. This expedition was undertaken in 1848, and only recorded for the information of the Society in 1900.

In the middle of the last century Tibet did not loom very large on the political horizon. The survey range of the Himalayas was for all practical purposes the ultimate boundary of British India, and the geography of that which lay beyond was a matter of absolute indifference to Government. It has taken just sixty years, from the first tentative expedition of Strachey over the border-line of Tibet to the present year of grace, to discover the position of the northern watershed of India. Indeed, until the return of the adventurous traveller, Sven Hedin, we shall not know even now exactly where to trace it on our maps. During those sixty years an immense impulse has been given to geographical discovery, and great has been the accumulation of knowledge in all branches of natural science relating to the Tibetan upland. But it is not too much to say that the information acquired by Strachey in that first excursion across the Himalayas, information geological, botanical, relating to glaciers and snowfall, or the nature and position of the sacred lakes which spread their blue surface to the sky within sight of the holy of holies—Kailas, has never been exceeded by any one traveller. In this as in every other work which he undertook, Sir Richard Strachey stands as a monument of

thoroughness. This quality indeed, added to his single-minded devotion to the best interests, not only of India, but of every undertaking which he controlled, is the key to his remarkable character and career. He died on February 9, 1908, at the advanced age of 91, and it may be written of him that his life's labours will surely be crowned with the wreath of immortality.

T. H. HOLDICH.

CORRESPONDENCE.

The Sources of our Present Information with regard to Lake Chad.

WITH reference to the review of Mr. Boyd-Alexander's 'From the Niger to the Nile' in the February *Journal*, I should like to call attention to the sources of our information about Lake Chad. When the geography of Africa was in its infancy, Denham and Clapperton gave us a real Lake Chad to replace the Lake Bornu of the early maps. Their journey was made in 1822-24, and Denham produced a map of the lake, except a portion of the east coast, which is dotted in. A quarter of a century after this Barth visited Chad, and, with his usual accuracy and care for detail, told us all he gathered from personal observation and otherwise, and even gave us the names of the thirteen islands that then existed; and Overweg confirmed Barth's statement. Vogel and Rohlf's were subsequently on the scene, and in 1870-72 Nachtigal examined the western and northern portion of its shores. From that time to the beginning of the present century Chad retained, on the maps, its stereotyped form, very much in the shape that Denham had depicted, until the remodelling was begun by Foureau, who in 1900, with Joalland, first gave a definite idea of the eastern shore; and the latter foreshadowed the separating cluster of islands in a map which was published in 1901.

Dubois, in April and May, 1902, surveyed the southern and south-eastern shore and islands, and his map appeared in the middle of 1903. The L'enfant Mission first gave the new shape to the lake, with the cluster of islands separating the two portions; and his map, which appeared on May 15, 1904, also shows the blocking up of the southern extension with marsh and swamp.

From the moment when Colonel Destenave took up the command of the Chad Military District, his officers have been ceaseless in their explorations of the lake. Audoin had been right round it and secured the general outline, and had spent much time surveying the clusters of islands; and after the completion of the work of the Niger-Chad Commission, Captain Tilho, with Audoin, D'Adhemar, Hardellet, and Jacques, covered the lake and its shores, the islands and marshes, with a network of routes. While D'Adhemar was surveying the south-eastern archipelago, the others were occupied on the south-eastern portion of the lake in December, 1902, August, 1903, and October, 1903, and surveyed the northern open water and its islands and shores in November, 1903, and March, 1904. The map embodying their work bears the imprint, "Aspect général en fin Avril 1904."

We have had this map, showing us the new state of affairs with regard to the lake, since the issue of the March number of *La Géographie* in 1906, and it is to the French officers that we owe, almost entirely, our present knowledge. Mr. Boyd-Alexander's book was published towards the end of last year, and in his map, which he bases on four positions determined astronomically by the French officers, he gives us some additional routes.

A. K.

Mr. Johnson's Ascent of E 61.

On p. 26 of the January number, and in reference to my remarks during the discussion of his paper, Dr. Workman says, "If any camp which Mr. Johnson thought approached this altitude (22,000 feet) was made, it must have been on the peak E 61, the only peak in the region exceeding 22,000 feet." He then points out that its assigned height of 23,890 feet was not accepted by the G.T.S., and goes on to say that therefore the altitude of Johnson's camp was wrongly estimated. Such a statement as this ought not to pass unnoticed in the *Geographical Journal*. Johnson's high camp was made in 1864, on his way to the Yarkand road from the neighbourhood of the Shayok river. He ascended E 61, many miles further to the east, in 1865, in the course of his celebrated journey to Ilchi (Khotan). Dr. Workman further implies that this question has only come up within the past year, but the mountaineering results of these two journeys were dealt with by Mr. Freshfield in the *Alpine Journal* for August, 1884, in which references are quoted.

Johnson's peak, E 61, is identical with K₁ of the G.T.S. and later maps ('Synopsis of Results,' etc., vol. 7, p. 400, footnote and p. 281). In reference to its disputed height of 23,890 feet, which was omitted from the map accompanying Johnson's paper in the *Proc. R.G.S.* for 1867, it is interesting to note that in the map to illustrate Dr. Stein's paper in the *Geographical Journal* for December, 1902, this identical peak appears as Muztagh, with an altitude of 23,890 feet attached to it. This map also shows Cholanglik Muztagh, 23,310 feet, 20 miles further to the south-west, and four other peaks over 23,000 feet in the same range.

There is no reason why a man who built "masonry platforms" at 21,500 feet, and took observations from a "quite extraordinary number of trigonometrical stations, which he established at over 20,000 feet" (*vide* Colonel Montgomerie in the *Proc. R.G.S.* for 1875), should not have reached an altitude of nearly 24,000 feet in such a region as the Kuen Lun.

TOM G. LONGSTAFF.

Ridgeland, Wimbledon, January 24, 1908.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907-1908.

Sixth Meeting, January 27, 1908.—DOUGLAS W. FRESHFIELD, Esq., Vice-President, in the Chair.

ELECTIONS.—Major John Grey Baldwin; Henry Balfour, M.A.; Bromley Challenor; Lieut. W. H. Coates, R.N.R.; Evan Lewis Davies; Captain Leonard William Lawson Everett; John William Edward Glover; Charles James Grist, M.A.; Major Lionel E. Kennard (15th Hussars); Georges Lecoq; Lieut. Francis Woodbine Parish (60th Rifles); George Platt; Thomas Smith; Captain Cyril Thornton; Rankin Wenlock; Arthur George Whitthorn-Cole, M.R.C.S.; Lloyd Williams.

The paper read was:—

"Exploration and Climbing in the Gurhwal Himalayas." By Dr. T. G. Longstaff.

Seventh Meeting, February 10, 1908.—The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*Henry Arthur Benyon; Fredk. Nicolai Dressing; James William Garson; Thomas B. Everard; Abdul Hamid; John William Leathley; Edward Fredk. William Lees, R.E.; James Black Love, M.A.; William Gilman Sewall; Major F. G. Talbot, D.S.O. (Rifle Brigade); John F. Wells.*

The paper read was:—

"The Story of London Maps." By Laurence Gomme.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., Librarian, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
 Abb. = Abhandlungen.
 Ann. = Annals, Annales, Annalen.
 B. = Bulletin, Bollettino, Boletim.
 Col. = Colonies.
 Com. = Commerce.
 C.R. = Comptes Rendus.
 E. = Erdkunde.
 G. = Geography, Géographie, Geografia.
 Ges. = Gesellschaft.
 I. = Institute, Institution.
 Iz. = Izvestiya.
 J. = Journal.
 Jb. = Jahrbuch.
 k.k. = kaiserlich und königlich.
 M. = Mitteilungen.

Mag. = Magazine.
 Mem. (Mém.) = Memoirs, Mémoires.
 Met. (mét.) = Meteorological.
 P. = Proceedings.
 R. = Royal.
 Rev. (Riv.) = Review, Revue, Rivista.
 S. = Society, Société, Selskab.
 Sc. = Science(s).
 Sitzb. = Sitzungsbericht.
 T. = Transactions.
 Ts. = Tijdschrift, Tidskrift.
 V. = Verein.
 Verh. = Verhandlungen.
 W. = Wissenschaft, and compounds.
 Z. = Zeitschrift.
 Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps. *Quarterly J. Geol. S.* 63 (1907): 294-308. **Bonney.**

On the Southern origin attributed to the Northern Zone in the Savoy and Swiss Alps. By Prof. T. G. Bonney. *Diagrams and Sections*

Alps. *Beiträge Geol. Karte Schweiz* 26 (1907) pp. 18 and 42. **Schmidt and Preiswerk.**

Geologische Beschreibung der Lepontinischen Alpen. Von Prof. Dr. C. Schmidt und Dr. H. Preiswerk. I. Teil. *Map and Sections.*

Alps—Railway. **Hardmeyer.**
 The St. Gothard railway. By J. Hardmeyer. 4th edition (Illustrated Europe, Nos. 189-192.) Zurich: O. Füssli, [not dated]. Size 7½ × 5, pp. 114. *Maps and Illustrations.*

Austria—Alps. *G. Jahresb. Österreich* 5 (1907): 113-155. **Machaček.**
 Die landeskundliche Literatur der österreichischen Alpenländer in den Jahren 1897-1905. Von Dr. Fritz Machaček.

- Austria—Carniola.** *Le globe : Mém. S.G. Genève* 46 (1907): 17-54. **Chaix**
 Contribution à l'étude des lapiés en Carniole et au Steinornes Meer. Par Emile Chaix et André Chaix. Avec un notice sur la Terra Bossa par Alfred Monnier. *Sketch-maps and Illustrations.*
- Austria—Carniola.** *Globus* 92 (1907): 12-15. **Mühlhofer.**
 Der mutmassliche Timavotalschluss. Von Loutnant Franz Mühlhofer. *Sketch-map and Section.*
 On the probable underground water-system of the Timavo
- Austria—Dalmatia.** **Holbach.**
 Dalmatia: the land where East meets West. By Maude M. Holbach. London: John Lane, 1908 [1907]. Size 8 x 5, pp 236. *Map and Illustrations.* Price 5s. net.
- Austria—Galicia.** *G. Jahresb. Österreich* 5 (1907): 65-79. **Budnytskyj.**
 Beiträge zur Morphologie des galizischen Dnestergebietes. Von Dr. Stefan Rudnytskyj.
- Belgium—Coal.**
 Coal-mining industry in Belgium. (Foreign Office, Miscellaneous, No. 664, 1907.) Size 9½ x 6, pp. 40. *Map, Illustrations, and Diagram.* Price 1s. 4½d.
- Belgium—Meuse.** *B.S. Belge Géologie* 21 (1907): 347-364. **Briquet.**
 La vallée de la Meuse en aval de Liège. Par A. Briquet. *With Sketch-maps and Section.*
- Europe—Historical.** **Temple.**
 The travels of Peter Mundy in Europe and Asia, 1608-1667. Vol. 1, *Travels in Europe, 1608-1628.* Edited by Lieut.-Colonel Sir Richard Carnac Temple. Cambridge, 1907. Size 9 x 5½, pp. lxiv and 284. *Maps and Facsimile Illustrations.* Presented by the Hakluyt Society
- Faroos.** **Currie.**
 The mineralogy of the Faeroes arranged topographically. By James Currie. (From the *Transactions of the Edinburgh Geological Society*, vol. 9, part i.) Size 8½ x 5½, pp. 68. *Map and Illustrations.*
- France.** **Vidal de la Blache.**
 [Paul] Vidal de la Blache. La France: tableau géographique. Paris: Hachette et Cie., 1908 [1907]. Size 12 x 9, pp. viii. and 366. *Maps and Illustrations.* Price 25 fr. Presented by the Publishers.
 See review of the first edition in vol. 23, p. 111. The illustrations form the principal addition in the present issue.
- France—Alpes Maritimes.** **Guebhard and Others.**
 Les Préalpes Maritimes. Par Adrien Guebhard. 2 vols. Paris, etc., 1904-1906. Size 10 x 6. *Illustrations and Sections.* Presented by the Author.
 Vol. 1, by M. Guebhard, describes geological excursions in the outer Alps. Vol. 2 is a collection of more technical papers by various authors.
- France—Basses Alpes.** *Ann. G.* 16 (1907): 223-214. **Levainville.**
 La vallée de Barcelonnette: notes de géographie humaine. Par J. Levainville. *With Sketch-map.*
- France—Touraine.** **Miltoun.**
 Castles and châteaux of old Touraine and the Loire country. By Francis Miltoun. London: Sir I. Pitman & Sons, 1907. Size 8 x 5½, pp. xii. and 348. *Map and Illustrations.* Price 7s. 6d. net.
- Germany—Hamburg.** **Uetzmann.**
 Die geographische Lage Hamburgs. Dissertation zur Erlangung der Doktorwürde. . . . Von Richard Uetzmann. Hamburg, 1906. Size 9 x 6, pp. 56. *Plan.* Price 2s.
 An instructive study on the influence of geographical position on the development of Hamburg.
- United Kingdom—Hertfordshire.** **Fordham.**
 Hertfordshire maps: a descriptive catalogue of the maps of the county, 1579-1900. By Herbert George Fordham. Hertford, 1907. Size 11½ x 9, pp. xii. and 182. *Facsimile-maps and Portrait.* Presented by the Author.
 A preface, notes, and indices have been added in this collective issue

United Kingdom—Historical.**Holmes.**

Ancient Britain and the invasions of Julius Cæsar. By Dr. T. Rice Holmes. Oxford: Clarendon Press, 1907. Size 9 × 6, pp. xvi. and 764. *Maps and Illustrations.* Price 21s. net. *Presented by the Publishers.*

United Kingdom—Historical.**Marshall.**

Through Great Britain and Ireland with Cromwell. By H. E. Marshall. London: T. C. & E. C. Jack, [not dated, 1907]. Size 7 × 5, pp. x and 142. *Maps and Illustrations.* Price 1s. 3d. *Presented by the Publishers.*

United Kingdom—Scotland.**Adam.**

The clans, septs, and regiments of the Scottish Highlands. By Frank Adam. Edinburgh, etc.: W. & A. K. Johnston, 1908 [1907]. Size 9 × 5½, pp. xxiv. and 506. *Map and Illustrations.* Price 15s. net. *Presented by the Author.*

United Kingdom—Waterways.

First Report (with Minutes of Evidence and Appendices) of the Royal Commission appointed to inquire into and to report on the Canals and Inland Navigations of the United Kingdom (pp. viii., x., 470, and 112). **Second Report (with Minutes of Evidence and Appendices) of the same** (pp. viii., xii., 322, iv., and 56). London, 1906 and 1907. *Maps.* Prices 6s. and 3s. 9d. *Presented by the Royal Commission.* [To be noticed elsewhere.]

ASIA.**Burma and Mesopotamia.****Beyllé.**

Prome et Samara: voyage archéologique en Birmanie et en Mesopotamie. Par le Général L. de Beylié. Paris: E. Leroux, 1907. Size 11 × 7½, pp. 146. *Plans and Illustrations.* *Presented by the Author.*

Central Asia. *B. Ecole Française Extrême Orient* 6 (1906) 255-269.**Pelliot.**

Notes sur l'Asie Centrale. Par Paul Pelliot. *Plans.*

Ceylon—Surveys.**Warren.**

Ceylon. Administration report, 1906. Part i. Civil Survey report of Mr. P. D. Warren, Surveyor-General. Size 13 × 8, pp. 34. *Map, Illustration, and Diagrams.* *Presented by the Surveyor-General.*

China.**Richthofen and Tiessen.**

Ferdinand von Richthofen's Tagebücher aus China. Ausgewählt und herausgegeben von E. Tiessen. 2 vols. Berlin: D. Reimer, 1907. Size 9½ × 6½, pp. (vol. 1) xiv. and 588, (vol. 2) iv. and 376. *Map and Illustrations.* Price 20m. *Presented by the Publisher.* [To be reviewed.]

China.**Willis and others.**

Research in China. Vol. 1, Part i. Descriptive topography and geology, by Bailey Willis, Eliot Blackwelder, and R. H. Sargent. Part ii. Petrography and Zoology, by Eliot Blackwelder; Syllabary of Chinese sounds, by Friedrich Hirth. [Atlas of] Geographical and geological maps. Washington: Published by the Carnegie Institution, 1906-07. Size (volume) 11½ × 9; (atlas) 22 × 18½, pp. xiv., iv., 528, and xxiv. *Maps and Illustrations.* Price 62s. 6d. [To be reviewed.]

China—Chili.*Petermanns M.* 53 (1907): 201-204**Berg**

Das Trappistenkloster Yan-kia-pung, westlich von Peking. Von Oberleutnant Detloff v. Berg. *With Map.*

China—Historical.**Sargent.**

Anglo-Chinese commerce and diplomacy (mainly in the nineteenth century) By A. J. Sargent. Oxford: Clarendon Press, 1907. Size 9 × 5½, pp. xii and 332. *Diagrams.* Price 12s. 6d. net. *Presented by the Publishers.* [To be reviewed.]

China—Ports**Hosie.**

Report on visit to southern ports of China. By Sir A. Hosie. Foreign Office, Miscellaneous No. 665, 1907. Size 9½ × 6, pp. 12.

China—Trade.

China: Imperial Maritime Customs 1. Statistical Series, No. 7. Native customs trade returns. No. 3, Quinquennial reports and returns, 1902-06. Shanghai, 1907. Size 11 × 8½, pp. 122. *Maps.*

Chinese Empire.**Filchner and others.**

Wissenschaftliche Ergebnisse der Expedition Filchner nach China und Tibet, 1903-1905. 10 Band, 1. Teil. 1. Abschnitt: Zoologische Sammlungen. 2. Abschnitt:

Botanische Sammlungen. Berlin: E. S. Mittler u. S., 1908 [1907]. Size 10×7 , pp. xii. and 288. *Map and Illustrations.* Presented by *Liept. Wilhelm Fitchner.*

Reports by a number of experts.

India.

Administration report of the Marine Survey of India, 1906-1907. Bombay, 1907. Size $13 \times 8\frac{1}{2}$, pp. 12.

India—Bengal.

Cunningham.

Plagues and pleasures of life in Bengal. By Lieut.-Colonel D. D. Cunningham. London: John Murray, 1907. Size $9 \times 5\frac{1}{2}$, pp. xii. and 386. *Illustrations.* Price 12s. net. Presented by the Publisher.

India—Burma.

Ireland.

Colonial Administration in the Far East. The province of Burma: a report prepared on behalf of the University of Chicago. By Alleyne Ireland. 2 vols. Boston, etc.: Houghton, Mifflin & Co., 1907. Size $10\frac{1}{2} \times 7$, pp. xxii., xvi., and 1024. *Maps.* Price \$20.

India—Himalaya. *Records Geol. Surv. India* 35 (1907) 123-137.

Hayden.

A preliminary survey of certain glaciers in the North-West Himalaya. By Officers of the Geological Survey of India.

Notes on certain glaciers in North-West Kashmir. By H. H. Hayden. *With Maps and Illustrations.*

India—Historical.

Biddulph.

The pirates of Malabar, and An Englishwoman in India two hundred years ago. By Colonel John Biddulph. London: Smith, Elder, & Co., 1907. Size 8×5 , pp. xx. and 328. *Map and Illustration.* Price 6s. net.

India—Mergui Archipelago. *Scottish G. Mag.* 23 (1907): 463-483.

Brown.

The Mergui Archipelago: its people and products. By R. N. Rudmose Brown. *With Illustrations.*

The writer lately paid a visit to this imperfectly known archipelago for the purpose of studying its pearl fishery.

India—Tide-tables.

Burn, Selby, and Hunter.

Tide-tables for the Indian Ports, 1908 (also January, 1909). By Major J. M. Burn, F. J. Selby, and J. de Graaff Hunter. 2 parts, pp. 1236.

Japan—Bibliography.

Wenckstern.

Bibliography of the Japanese empire. Being a classified list of the literature in European languages relating to Dai Nihon [Great Japan]. . . Vol 2, comprising the literature from 1894 to the middle of 1906. . . Compiled by Fr. von Wenckstern. Tokyo (London: B. Quaritch), 1907. Size $10 \times 5\frac{1}{2}$, pp. xvi, 486, 28, and 22. Presented by the Publisher.

Evidently compiled with great care and labour. Vol 1, dealing with the years 1859-93, appeared in 1895.

AFRICA.

Abyssinia.

Litt. G. Italiana 14 (1907): 490-491.

Tancredi.

Un vulcano della Danalia in eruzione. Del Cap. A. M. Tancredi.

* A new focus of eruption is reported to have been formed on the western flank of Mount Afdera, in about $13^{\circ} 15' N$.

Abyssinia.

Beccari and Almeida.

Rerum Æthiopicarum scriptores occidentales inediti a sæculo xvi. ad xix., curante C. Beccari. Vol. 5. P. Emmanuelis d'Almeida. Historiæ Æthiopiæ; Liber i.-iv. Rome, 1907. Size $10\frac{1}{2} \times 7\frac{1}{2}$, pp. lxiv. and 526. *Facsimile Map.* Price 20s. 8d.

The editor supplies a critical introduction, in Latin, of 64 pp., and there is a facsimile of the original map.

Africa—Islam.

Questions diplomatiques 24 (1907): 436-447.

Gaden.

Les états musulmans de l'Afrique centrale et leurs rapports avec la Mecque et Constantinople. Par le Commandt Gaden.

Africa—Meteorology. *T.S. African Philosoph.* 8. 16 (1907): 437-442

Claxton.

Note on the connection between the rainfall at Durban and Mauritius. By T. F. Claxton.

Africa—Railways.

Die Eisenbahnen Afrikas: Grundlagen und Gesichtspunkte für eine koloniale Eisenbahnpolitik in Afrika. Nach der gleichnamigen amtlichen Denkschrift herausgegeben vom Kolonialpolitischen Aktionskomitee. Berlin: W. Süsserott, 1907. Size $10 \times 7\frac{1}{2}$, pp. viii. and 164. *Maps. Presented by the Kol. Aktionskomitee.*

Algeria.

A travers le monde 13 (1907): 345-348.

Desfontaines.

Les territoires du sud de l'Algérie. limitation nouvelle et situation économique. Par C. Desfontaines. *Sketch-map and Illustrations.*

Angola.

Report for the year 1906 on the trade and commerce of Angola. (Foreign Office, Annual, No. 3928, 1907.) Size $9\frac{1}{2} \times 6$, pp. 40. Price $2\frac{1}{2}d$.

British East Africa.

Hutchins.

East Africa Protectorate. Report on the forests of Kenya. By D. E. Hutchins. Colonial Report, Miscellaneous, No. 41. London, 1907. Size $9\frac{1}{2} \times 6$, pp. 40. Price $2\frac{1}{2}d$.

See note in the February number, p. 218.

British East Africa.

Papers relating to British East Africa. London, 1907. Size $13 \times 8\frac{1}{2}$, pp. 62. Price 6d.

Concerned chiefly with the land-settlement question.

British West Africa—Cotton.

The British Cotton-growing Association [Publication] No. 22. Experimental work in West Africa. No. 2. Manchester, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 48.

Egypt and Sudan.

Baedeker.

Egypt and the Sudan. Handbook for travellers by Karl Baedeker. Sixth remodelled edition. London: Dulau & Co., 1908 [1907]. Size $6\frac{1}{2} \times 4$, pp. cxxxiv. and 440. *Maps and Plans.* Price 15 marks. *Presented by the Editor.*

The editor has had the collaboration, amongst others, of the well-known Egyptologist, Prof. G. Steindorff, of Leipzig.

French Congo.

Chevalier.

Mission Chari—Lac Tchad, 1902-1904. L'Afrique Centrale Française. récit du voyage de la mission par Auguste Chevalier. Paris: A. Challamel, 1907. Size $11 \times 7\frac{1}{2}$, pp. xvi. and 776. *Maps and Illustrations.* Price 20 fr. *Presented by the Author.* [To be reviewed.]

Somaliland, British

Swayne.

A woman's pleasure trip in Somaliland. By Frances Swayne. London: Simpkin & Co., 1907. Size $7\frac{1}{2} \times 5\frac{1}{2}$, pp. xii. and 172. *Sketch-map and Illustrations.* *Presented by the Author.*

South Africa.

Brown.

The guide to South Africa . . . edited annually by A. Samler Brown and G. Gordon Brown. 15th edit., 1907-1908. London: Sampson Low & Co., [1907]. Size $7\frac{1}{2} \times 5$, pp. lvi. and 478. *Maps, Plans, and Sections.* Price 2s. 6d. *Presented by the Union Castle Mail Steamship Co.*

NORTH AMERICA.**Alaska.**

J. Geology 15 (1907). 415-433

Blackwelder.

(Glacial features of the Alaskan coast between Yukutat Bay and the Alsek River. By Eliot Blackwelder. *With Map and Illustrations*

Alaska.

U.S. Geol. Surv. B. 287 (1907). pp. xii. and 162

Spencer and Wright

The Juneau gold belt, Alaska, by Arthur C. Spencer; and A reconnaissance of Admiralty Island, Alaska, by Charles Will Wright. *With Maps, Illustrations, and Diagrams*

America—Ethnology.

Friederici.

Der Tränengruss der Indianer. Von Dr. Georg Friederici. Leipzig: Simmel & Co., 1907. Size $9\frac{1}{2} \times 5$, pp. 22. Price 1m. *Presented by the Publishers.*

California—Colorado River. *Scottish G. Mag.* 23 (1907). 360-363.

Redway.

The Vagaries of the Colorado River. By Jacques W. Redway. *With Map.*

Written before the river was finally brought under control. (*Journal*, vol. 30, p. 564).

California—Sierra Nevada. *Appalachia* 11 (1907): 239-248. **Church.**
Summit temperatures in winter in the Sierra Nevada. By J. E. Church. *With Illustrations.*

Canada—Gulf of St. Lawrence. **Dawson.**
The currents in Belle Isle Strait, from investigations of the Tidal and Current Survey in the seasons of 1894 and 1906. W. Bell Dawson in charge. Ottawa, 1907. Size 10 x 6½, pp. iv. and 44. *Chart and Diagrams.*

Canada—Historical. *P. and T.R.S. Canada* 12 (1906). Sect. 1, 65-81. **Prud'homme.**
Les successeurs de La Vérendrye sous la domination française. Joseph Flourimont de Noyelles, Jacques Repentigny Le Gardeur, Sieur de Saint-Pierre, et Saint-Luc de la Corne; 1743-1755. Par L. A. Prud'homme.

Canada—New Brunswick. *B. Nat. Hist. S. New Brunswick* 5 (1907): 519-546. **Ganong.**
Notes on the Natural History and Physiography of New Brunswick. Nos. 101-106. By W. F. Ganong. *With Maps.*

Continuation of the valuable series of papers, which has been in course of publication for some years.

Canada—Relief. *P. and T.R.S. Canada* 12 (1906). Sect. iv., 67-82. **Poole.**
Features in the continental shelf off Nova Scotia. By H. S. Poole. *Map.*

Canada—Rocky Mountains. *Appalachia* 11 (1907): 221-229. **Walcott.**
The first ascent of Mount Mummery. By Robert Walcott. *With Illustrations.*

United States—Commercial. **Oppel.**
Wirtschaftsgeographie der Vereinigten Staaten von Nordamerika. Von Prof. Dr. A. Oppel. (Angewandte Geographie. . . III. Serie, 2 Heft.) Halle a. S.: Gebauer-Schwetschke, 1907. Size 8½ x 5½, pp. [vi.] and 160. *Diagrams.* Price 3s. 6d.

United States—Virginia. **Kingsbury.**
The records of the Virginia Company of London. The Court Book, from the manuscript in the Library of Congress. Edited . . . by Dr. Susan Myra Kingsbury. 2 vols. Washington: Government Printing Office, 1906. Size 11½ x 9, pp. (vol. 1) 686; (vol. 2) 612. *Facsimiles.* Price \$4.

A reprint of a document of great importance for the early history of British enterprise in America. There is a good introduction and other illustrative matter.

CENTRAL AND SOUTH AMERICA.

Argentina. *La G., B.S.G.* Paris 16 (1907): 81-100. **Schrader.**
En Argentine. Par F. Schrader.
Impressions gained during two visits to the country.

Argentina Exhibition. [**Holder.**]
A record of the proceedings of the British Argentine Exhibition held in Buenos Aires, November 25th to 29th, 1905. [Compiled by A. Holder.] Buenos Aires, [1906]. Size 10½ x 7, pp. 124. *Maps and Diagrams.* Presented by Señor F. Moreno.

Argentina—Population. **Carrasco.**
El crecimiento de la población de la República Argentina 1895-1906. Por Gabriel Carrasco. Buenos Aires, 1907. Size 10½ x 7, pp. 14.

Bolivia. **Crespo.**
Ministerio de Colonización y Agricultura. Indicaciones sumarias para el inmigrante a Bolivia. Por Luis S. Crespo. La Paz, 1907. Size 8 x 5½, pp. vi. and 160. *Maps and Illustrations.*

Bolivia. *Tour du Monde* 13 (1907): 97-118, 121-156. **Barbier.**
Un pays jeune du Pacifique. In Bolivie. Par Émile Barbier. *With Sketch-maps and Illustrations.*

Bolivia. **Vacano and Mattis.**
Bolivien in Wort und Bild. Aus seiner Vergangenheit, Gegenwart und Zukunft. Von Max Josef von Vacano und Hans Mattis. Berlin: D. Reimer, 1906. Size 10 x 7, pp. viii. and 234. *Map and Illustrations.* Price 10s.
A descriptive account of the country.

Bolivia—Ethnology. **Quevedo.**
La lengua Leca de los ríos Mapurí y Beni según los MSS. de los P.P. Cardús y

- Herrero.** *Arreglados y anotados por S. A. Lafone Quevedo.* Buenos Aires, 1905. Size 10 x 6½, pp. 5-180. *Map.*
- Brazil—Bahia.** *B.S.G. Com. Bordeaux* 30 (1907): 174-180, 199-208. **Verrier.**
Les populations sauvages de l'Etat de Bahia. Par Dr. G. Verrier. *With Portrait and Illustrations.*
- Brazil—Rio de Janeiro.** *Rev. I. Hist. e G. Brasileiro* 67 (1906) Part 2, 263-396 **Silva.**
Chorographia Fluminense (O Estado do Rio de Janeiro em 1896). Por Antonio José Caetano da Silva.
- Chile—Andes.** *C.R.A. Sc. Paris* 145 (1907) 311-317 **Schrader.**
Determination de l'altitude du sommet de l'Aconcagua (Cordillere des Andes).
 Par Fr. Schrader.
 M. Schrader places the height at 22,812 feet, as against the 23,080 of Mr. Fitzgerald's expedition, to which he makes no reference. See February number, p. 221.
- Chile—Phytogeography.** **Reiche.**
Die Vegetation der Erde: Sammlung pflanzengeographischer Monographien, herausgegeben von A. Engler und O. Drude. VIII. *Grundzuge der Pflanzenverbreitung in Chile, von Dr. Karl Reiche.* Leipzig, W. Engelmann, 1907. Size 10 x 7, pp. xiv. and 374. *Maps and Illustrations.* Price 20m.
- Ecuador—Archæology.** **Saville.**
Contributions to South American Archeology: the George G. Heye expedition. (Vol. 1.) The antiquities of Munabi, Ecuador. A preliminary report. By Marshall H. Saville. Size 13 x 9½, pp. viii. and 136. *Illustrations. Presented by the Author and George G. Heye, Esq.*
- Peru—Historical.** **Markham.**
History of the Incas. By Pedro Sarmiento de Gamboa; and *The Execution of the Inca Tupac Amaru, by Captain Baltasar de Ocampo.* Translated and edited by Sir Clements Markham. (Hakluyt Society Publications, Second series, No. xxiii.) Cambridge, 1907. Size 9 x 5½, pp. xxii. and 396. *Map and Facsimile Illustrations. Presented by the Hakluyt Society.*
- Tierra del Fuego.** **Crawshaw.**
The birds of Tierra del Fuego. By Captain Richard Crawshaw. London: B. Quaritch, 1907. Size 11½ x 7½, pp. xl and 158. *Map and Illustrations. Presented by the Author.*
 This splendidly illustrated work will be reviewed elsewhere.

AUSTRALASIA AND PACIFIC ISLANDS.

- New Guinea—Dutch.** *Ts. K. Nederlandsch Aardr. Genoots.* 24 (1907) 547-631. **Hille**
Reizen in West-Nieuw-Guinea. III. Door J. W. van Hille, waarnemend Assistent-Resident van West-Nieuw-Guinea. *With Map.*
- New Guinea—Dutch.** **Hellwig.**
Ts. K. Nederlandsch Aardrijksk. Genoots. 24 (1907). 845-854.
Exploraties aan de Zuidwestkust van Nieuw-Guinea. Door R. L. A. Hellwig.
- New Guinea—Ethnology.** **Pösch.**
Reisen in New Guinea in den Jahren 1904-06. Von Rudolf Pösch. (Aus der *Zeitschrift für Ethnologie*, Heft 3, 1907) Size 9½ x 6½, pp. 382-400. *Illustrations.*
 See account of Dr. Pösch's journeys in the December number.
- New Zealand—Kapiti Island** **Cockayne.**
New Zealand, 1907. Report on a botanical survey of Kapiti Island. By L. Cockayne. Size 13½ x 8½, pp. 24. *Maps and Illustrations. Presented by the Author.*
- New Zealand—Surveys.** **Kensington and Humphries.**
Report of the Department of Lands and Survey. New Zealand, 1906-07. By William C. Kensington and Thomas Humphries. Wellington, 1907. Size 13 x 8½, pp. (Part C. 1.) ii. and 128; (Part C. 1a) 36; (Part C. 1b) 38; and (Part C. 4) 50. *Maps, Illustrations, and Diagrams.*
- Pacific Islands—Ethnology** **Macdonald.**
The Oceanic languages: their grammatical structure, vocabulary, and origin. By Dr. D. Macdonald. London: H. Frowde, 1907. Size 7½ x 5, pp. xvi. and 752. *Maps. Price 10s 6d. net. Presented by the Publisher.*

POLAR REGIONS.

Antarctic—French Expedition.

Institut de France: Académie des Sciences. Instructions pour l'expédition antarctique organisée par le Dr. Jean Charcot. Paris, 1907. Size $6\frac{1}{2} \times 4\frac{1}{2}$, pp. 48.

Arctic.

Riv. d. Italiana 14 (1907). 492-494

Faustini.

Sulla opportunità di suddividere in quadranti la regione polare artica. Di A. Faustini.

Arctic—Coal.

B.S.G. Italiana 8 (1907). 983-1005.

Faustini.

I giacimenti di combustibili fossili nella regione artica. Note di A. Faustini. *With Maps.*

Arctic—North-West Passage.

Amundsen.

Road Amundsen. Die Nordwest-Passage: meine Polarfahrt auf der *Gjöra*. Munich: A. Langen, 1908 [1907]. Size 9×6 , pp. xiv. and 544. *Maps and Illustrations.* Price 12m. Presented by the Publisher. [To be reviewed.]

Greenland.

Först.

Geschichte der Entdeckung Grönlands von den ältesten Zeiten bis zum Anfang des 19. Jahrhunderts. Inaugural-Dissertation von Johannes Först. Worms, 1906. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 72. Price 1s. 3d.

A useful summary, based on the best authorities.

Polar Regions

G.Z. 13 (1907): 465-478

Nordenskjöld.

Ueber die Natur der Polarländer. Von Otto Nordenskjöld.

MATHEMATICAL GEOGRAPHY.

Cartography.

B.S.G. Italiana 8 (1907). 785-795.

Crema.

Carte topografiche stereoscopiche. Nota del tenente C. F. Crema. *With Diagrams.*

Discusses the possibility of obtaining a stereoscopic effect by the use of specially prepared maps and apparatus.

Cartography

Z. Ges. E. Berlin (1907). 539-555.

Eckert.

Die Kartographie als Wissenschaft. Von Prof. Dr. Max Eckert.

Cartography—Methods. *M. k.k. militär. I* 26 (1906). 172-176.

Glotz.

Ueber Reproduktion lavierter Terrainzeichnungen. Von Wilhelm Glotz. *With Map.*

On mechanical methods of reproducing relief-shading done by brushwork.

Cartography Projections. *B.S.R. G. Ancers* 31 (1907). 65-94.

Duchesne.

L'enseignement des projections cartographiques. Par Charles Duchesne. *With Diagrams.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Climatology.

Meteorologische Z. 24 (1907). 433-444.

Knoche

Die äquivalente Temperatur ein einheitlicher Ausdruck der klimatischen Faktoren

"Lufttemperatur" und "Luftfeuchtigkeit." Von Walter Knoche. *Diagrams*

"Equivalent temperature" is a term invented by Herr von Bezold to combine the factors of temperature and humidity, and is recommended by the writer as the best criterion of varieties of climate. His view has since been contested by Dr. J. Hann.

Geological History. *Naturw. Wochenschrift* 22 (1907). 673-679

Arlt.

Zur Atlantisfrage. Von Dr. Th. Arlt. *Map*

Geology.

Haug.

Émile Haug. *Traité de géologie. I. Les phénomènes géologiques.* Paris: A. Colin, 1907. Size $10 \times 6\frac{1}{2}$, pp. 546. *Maps, Illustrations, and Diagrams* Price 12 fr. 50. Presented by the Publisher

Geology—Loess.

Z. Ges. E. Berlin (1907). 374-377.

Rühl.

Ueber die ungleicheitige Verbreitung der Löss an den Talgehängen. Von Dr. Alfred Rühl

Geology—Soils.

Schwarz.

Agricultural geology. By Prof. E. H. L. Schwarz. [Reprinted from the *Natal Agricultural Journal*, vol. 10, No. 8. 1907.] Size 10×6 , pp. 14.

Among other points emphasized is the importance of bacteria in preparing the soil for the support of plant-life.

- Geomorphology.** *Beiträge Geophysik* 9 (1907): 78-95. **Arlt.**
Die antipodische Lage von Land und Meer. Von Dr. Th. Arlt. *With Map.*
- Geomorphology.** *G. Anzeiger* 8 (1907): 176-178, 197-199. **Arlt.**
Verschwundene Inseln und versunkene Kontinente. Von Dr. Th. Arlt.
- Geomorphology.** *J. Geology* 15 (1907): 560-570. **Arnold.**
Dome structure in conglomerate. By Ralph Arnold. *With Illustrations*
- Geomorphology—Dunes.** **Günther.**
Sitzungsber. math.-phys. Kl. A.W. München (1907) 139-153
Ein naturmodell der Dünenbildung. Von Siegmund Günther *With Diagrams.*
- Geomorphology—Steppes.** *Naturw. Wochenschrift* 22 (1907): 705-707. **Gessert.**
Unterschiede des Bodens in Steppen verschiedener Klimate. Von Ferdinand Gessert.
- Geophysics.** **Darwin.**
Scientific papers. By Sir George Howard Darwin. Vol. 1, Oceanic tides and lunar disturbance of gravity. Cambridge. University Press, 1907. Size 10½ × 7, pp. xiv. and 464. *Diagrams*. Price 15s. net. *Presented by the Publishers*
- Seismology.** **Hobbs.**
Earthquakes: an introduction to seismic geology. By William Herbert Hobbs. New York: D. Appleton & Co., 1907. Size 8 × 5, pp. xxxii and 336. *Maps, Illustrations, and Diagrams.* Price \$2 net. *Presented by the Publishers.* [To be reviewed.]
- Seismology.** **Montessus de Ballore.**
Comte de Montessus de Ballore. La science seismologique. Les tremblements de terre. Paris: A. Colin, 1907. Size 10 × 6½, pp. viii. and 580. *Maps, Illustrations, and Diagrams.* Price 16 fr. *Presented by the Publisher* [To be reviewed.]

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

- Anthropogeography.** *B. American G.S.* 39 (1907): 383-397, 449-463. **Semple.**
Geographical boundaries. By Ellen Churchill Semple.
Noticed in the Monthly Record, January, p. 109.
- Anthropogeography.** *G.Z.* 13 (1907): 505-517. **Schlüter.**
Ueber das Verhältnis von Natur und Mensch in der Anthropogeographie. Von Otto Schlüter.
- Anthropogeography—Commerce.** **Speck.**
Handelsgeschichte des Altertums. Von E. Speck. 3 vols. I Die orientalischen Völker (pp. viii. and 592); II Die Griechen (pp. viii and 582); III., 1. Hälfte Die Karthager, u.s.w. (pp. viii. and 536); III., 2. Hälfte. Die Römer (pp. iv. and 1154). Leipzig: F. Brandstetter, 1900-1906. Size: 8½ × 6. Price 35m.
- Commercial.**
Tables showing the progress of merchant shipping in the United Kingdom and the principal maritime countries [to the year 1906]. London, 1907. Size 13 × 8½, pp. 88.
- Commercial.** **Day.**
A history of Commerce. By Clive Day. New York & London Longmans & Co., 1907. Size 8 × 5½, pp. xlv. and 626. *Maps.* Price 7s. 6d. net. *Presented by the Publishers.* [To be reviewed.]
- Commercial.** **Friedrich.**
Allgemeine und spezielle Wirtschaftsgeographie. Von Dr. Ernst Friedrich. Zweite Auflage. Leipzig. G. J. Göschen, 1907. Size 9 × 6, pp. 468. *Maps.* Price 6m. 80. *Presented by the Publishers.*
The first edition was reviewed in vol. 24, p. 581. The work has now been revised and extended.
- Commercial—Shipping.** **Almeida.**
Le centenaire de la navigation à vapeur et l'Exposition Maritime de Bordeaux. Par P. Camena d'Almeida, Bordeaux, 1907. Size 10½ × 7, pp. 36.
- Historical.** **Beasley.**
Directorium ad faciendum passagium transmarinum. Edited by C. Raymond

Beazley. (Reprinted from the *American Historical Review*, vol. 13, No. 4, and vol. 13, No. 1, July and October, 1907.) Size $10\frac{1}{2} \times 7$, pp. 810-857 and 66-115. *Presented by the Editor.* [See note at p. 342, ante.]

Historical—Ibn Jubayr.

Wright.

The travels of Ibn Jubayr, edited from a manuscript in the University Library of Leyden by William Wright. 2nd edition, revised by M. J. de Goeje. [Arabic text and notes only.] Leyden. E. J. Brill; London: Luzac & Co., 1907. Size 10×6 , pp. 53 and 363. *Presented by the E. J. W. Gibb Memorial Trustees.*

BIOGRAPHY.

Böttogo. *D.S.G. Italiana*, iv. 8 (1907). 1075-1088. Millosevich.

Commemorazione di Vittorio Böttogo letta a Parma il 26 Settembre, 1907 Dal Prof. Elia Millosevich. *Portrait and Illustration.*

Böttogo. *Riv. Col.* 4 (1907): 175-199 Mori.

L'opera di Vittorio Böttogo. Del Dott. Angiolo Mori. *Illustration*

Buchan. *Symons Mel Mag.* 42 (1907). 103-106

Alexander Buchan. 1829-1907

Diaz.

Porfirio Diaz and his work. By a soldier of the Old Guard Mexico, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 128. *Plan and Illustrations.*

GENERAL.

Educational. Mackinder.

The development of geographical teaching out of nature study. An address by H. J. Mackinder. London G. Philip & Son, 1908. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 16. *Presented by the Publishers.*

Geography—Text-book.

Mill.

The International Geography. By seventy authors Edited by Dr. Hugh Robert Mill. [4th edit.] London: Macmillan & Co., 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. xx. and 1088. *Maps, Illustrations, Diagrams, etc.* Price 15s. *Presented by the Publishers.*

This work has again been revised and brought up to date for its issue by Macmillan & Co.

Geography—Text-book

Young.

A rational geography. By Ernest Young Part i. London: G. Philip & Son, 1907. Size $7\frac{1}{2} \times 5$, pp. xii. and 196 *Sketch-maps, Illustrations, and Diagrams.* Price 1s. 6d. *Presented by the Publishers.* [To be reviewed]

Portuguese Colonies.

Negreiros.

A de Almada Negreiros. Les colonies portugaises. Études documentaires: produits d'exportation. Paris: A. Challamel, [not dated, 1906]. Size $7\frac{1}{2} \times 5$, pp. 370. *Illustrations.* *Presented by the Author*

Travel—Europe and Asia.

Barsini.

Prince Scipion Borghèse De Pekin à Paris. la moitié du monde vue d'une automobile en soixante jours Relation de voyage par . . . Louis Barzini Paris: Hachette et Cie., 1908 [1907] Size 10×7 , pp. xvi and 448 *Maps and Illustrations* Price 12 fr. *Presented by the Publishers.*

NEW MAPS.

By E. A. REEVES, Map Curator, R.G.S.

EUROPE.

Austria-Hungary.

Freytag.

G. Freytag's Verkehrskarte von Österreich-Ungarn mit den Balkanländern. Scale 1:500,000 or 1 inch to 7.8 stat. miles. Vienna: G. Freytag & Berndt, 1908. Price 2 kr. *Presented by the Publisher.*

England and Wales.

Ordnance Survey.

Sheets published by the Director-General of the Ordnance Survey, Southampton, from January 1 to 31, 1908.

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England—London.

Stanford.

A new map of Metropolitan railways, tramways, and miscellaneous improvements, deposited at the London County Council, November 30, 1907, for Session 1908. Scale 1: 63,360 or 1 inch to 1 stat. mile. London. Edward Stanford, 1908. Price, 1s. 6d.

Europe—Central.

K. Preussische Landesaufnahme

Topographische Spezialkarte von Mittel-Europa. Herausgegeben von der kartographischen Abtheilung der K. Preussische Landesaufnahme. Scale 1: 200,000 or 1 inch to 3.1 stat. miles. Sheets. 355, Brüssel, 418, Worms, 568, Freiburg i. Br. Berlin: K. Preussische Landesaufnahme, 1907. Price 1.50m. each sheet.

Europe—Central.

K. Preussische Landesaufnahme.

Übersichtskarte von Mitteleuropa. Herausgegeben von der Kartogr. Abteilung der Kgl. Preuss. Landesaufnahme. Scale 1: 300,000 or 1 inch to 1.7 stat. miles. Sheets: Aalborg, Grenau, Hamburg; Kiel, Leeuwarden, Oldenburg. Berlin: K. Preussische Landesaufnahme, 1907. Price 1.50m. each sheet.

Germany.

K. Preuss. Landesaufnahme.

Karte des Deutschen Reiches. Herausgegeben von der Kartogr. Abteilung der Kgl. Preuss. Landesaufnahme. Scale 1: 100,000 or 1 inch to 1.6 stat. miles. Sheets: 346, Grünberg; 365, Düben. Berlin: K. Preussische Landesaufnahme, 1907. Price, 1.50m. each sheet

Norway.**Norges Geografiske Opmaaling.**

Topografisk Kart over Kongeriget Norge. Scale 1: 100,000 or 1 inch to 1·6 stat. mile. Sheets: K. 14, Belordalen; S. 4, Bergsfjorden; W. 1, Nordkræp; W. 7, Iskurms; 4 A, Fløkkefjord; 9 B, Lærvik. Christiania: Norges Geografiske Opmaaling, 1907. *Presented by the Norwegian Geographical Institute.*

Norway—Finmark.**Norges Geografiske Opmaaling.**

Kart over Finmarkens Amt. Udgivet af Norges Geografiske Opmaaling, 1907. Scale 1: 500,000 or 1 inch to 7·9 stat. miles. Christiania: Norges Geografiske Opmaaling, 1907. *Presented by the Norwegian Geographical Institute.*

ASIA.**Asia Minor****Kiepert.**

Karte von Kleinasien. Bearbeitet von Dr. Richard Kiepert. Scale 1: 400,000 or 1 inch to 6·3 stat. miles. Sheet A. III, Zafatanboht. Berlin: Dietrich Reimer (Ernst Vohsen), [1908].

The publication of this sheet completes Dr. R. Kiepert's large and important map of Asia Minor, the first sheet of which appeared in 1902. Since no survey of the region on a systematic basis exists, the materials for the construction of the map consist chiefly of route traverses and sketches of varying merit, adjusted here and there to positions which have been determined astronomically with more or less accuracy. Admiralty charts serve for the delineation of the coast-line, and occasionally a fairly accurate survey, such as that for the line of railway, furnishes reliable data for a limited area; but with these exceptions the cartographical material is rough and conflicting, and to construct anything like a satisfactory map on a large scale at the present time is no light undertaking. However, Dr. R. Kiepert has had many advantages, not the least being that he is in possession of the great mass of material collected by his father, the late Dr. H. Kiepert, from his own surveys and other sources, some of which were published in his map of Asia Minor as long ago as 1841. Availing himself of these and other sources of information, the author has been able to produce a most creditable map, which, if not altogether correct in parts, contains most valuable information, and is far more complete in detail than any other hitherto published. The labour involved in the compilation must have been enormous, and it is hoped that the sheets will be kept up to date and corrected as fresh information is forthcoming and errors in place-names and topography are detected. The map is in twenty-four sheets, each measuring 19 x 24 inches, and is well executed. Hills are shown by brown shading. Parts mapped from material taken from Turkish and Greek authorities, and all ancient names, are distinguished by the style of lettering.

India.**Joppen.**

Historical atlas of India for the use of High Schools, Colleges, and Private Students. By Charles Joppen, A.J. London: Longmans, Green, & Co., 1907.

Price 3s. net. Presented by the Publisher.

This useful little atlas contains a series of twenty-six coloured maps of India, printed at the establishment of Justus Perthes, Gotha, which will enable a student to follow the leading events connected with the history of India from the earliest times. Sixteen pages of text, dealing with leading historical facts and data, are given at the commencement of the atlas, which should be studied in connection with the maps. The atlas is intended for school and college students, and no attempt has been made to furnish a set of detailed maps for the use of mature scholars. The following is a list of the maps:—

Alexander's Empire, 326 B.C.; India in the Second Century A.D.; India in 350 A.D.; The Empire of the White Huns in the Beginning of the Sixth Century A.D.; India in the Seventh Century A.D.; India in 1022; India in 1236; India in 1318; India in 1398; India in 1525; India in 1605; India in 1700. To illustrate the Early Mahratta History: Mysore, the Dominions of Chik Deo Raja Wodeyar, 1701. To illustrate the wars between the English and French in the Carnatic: India in 1751; Hyder's Dominions in 1780. To illustrate the four Mysore wars (1784) India in 1795; India in 1805; India in 1823; India in 1848; India in 1856. The Growth of British Bengal and Burma; The Indian Empire in 1907 A.D.

AFRICA.**Abyssinia.****Bieber.**

West-Gallaland. Routen der Expedition v. Mylius-Bieber (Adis Ababa-Dachirren), 1905. Aufgenommen von Friedrich J. Bieber. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. *Petermanns Mitteilungen, Jahrgang 1908, Tafeln 1. u. 2.* Gotha: Justus Perthes, 1908. *Presented by the Publisher.*

No. III.—MARCH, 1908.

2 B

The route followed by the Mylius-Bieber expedition was due south from Adis Ababa for about 40 miles, thence west and south-west for about another 140 miles to Jiren and the Didesa river. The map is from a route survey by Herr F. J. Bieber, and accompanies his account of the expedition given in *Petermanns Mitteilungen* for January last. No attempt has been made to show latitudes and longitudes.

Africa.**Topographical Section, General Staff.**

Map of Africa. Compiled in the Topographical Section, General Staff. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. (Provisional) Sheets: 17-D and J, El Arish; 17-I and part of C, Port Said; 17-K and part of E, Rafah; 17-L and part of F, Mt. Hor; 17-O, Suez; 17-P, Nakhl; 17-Q, Wadi Taba; 17-R, Akaba. London: Topographical Section, General Staff, War Office, 1907. *Price 1s. 6d. each sheet. Presented by the Director of Military Operations.*

Egypt.**Survey Department, Cairo.**

Topographical map of Fayum Province. Scale 1: 10,000 or 6·3 inches to 1 stat. mile. Sheets: s.e. 12-2, 13-1, 15-1, 17-1. s.w. 13-9, 14 1, 14-13, 15-1, 17-1, 17-2, 17-3, 17-4, 17-5, 17-6, 17-7, 17-9, 17-10, 17-11, 18-1, 18-2, 18-3, 18-4, 18-5, 18-6, 18-9, 19-1, 19-2, 19-3, 19-4, 19-5, 19-9, 20-2, 20-9. Topographical map of Qaliubia Province. Scale 1: 10,000 or 6·3 inches to 1 stat. mile. Sheets: n.e. 5-4, 6-4, 6 5, 6 6, 9-3. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Gold Coast.**Guggisberg.**

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.O.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale: 1: 125,000 or 1 inch to 1·9 stat. mile. Sheets: 72 K. IV. Fumas; 72 Q. II. Prahan (Praso). Edinburgh and London: W. & A. K. Johnston, 1907. *Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.*

Transvaal.**Geological Survey.**

Transvaal Geological Survey. Scale 1: 150,000 or 1 inch to 2·4 stat. miles. Sheet 1, Pretoria. With Explanation. Pretoria: Government Printing and Stationery Office, 1907. *Presented by the Director, Geological Survey of the Transvaal.*

This is the first sheet of the Geological Survey of the Transvaal, and includes an area of about 2200 square miles around Pretoria. The geological work was done between the years 1903 to 1906 by Messrs. H. Kynaston, E. T. Mellor, and A. L. Hull, supplemented by that of Mr. F. A. Steart in the immediate neighbourhood of Pretoria. The sheet is well printed in colours, and is accompanied by a descriptive pamphlet by Mr. H. Kynaston, B.A., F.G.S., the director of the survey.

AMERICA.**Chile.****Oficina de Limites, Santiago.**

Comision Chilena de Limites. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. Sheets: Antofagasta; Atacama. Santiago: Oficina de Limites, [1907]. *Presented by the Oficina de Limites, Santiago*

The topographical sheets include the Andine boundary region between 22° and 23° S. and 25° and 26° S. Those showing the lines of traverse and triangulation include the same latitude, but in longitude extend from 66°20' to 67°50' W. and 66°50' to 69°10' W.

Mexico.**Secretaria de Comunicaciones y Obras Publicas.**

Carta de Ferrocarriles de los Estados Unidos Mexicanos. Scale 1: 2,000,000 or 1 inch to 31·5 stat. miles. 2 sheets. Mexico: Secretaria de Comunicaciones y Obras Publicas, [1907].

A blue-print of an official map by the Secretary of Communications and Public Works of Mexico, showing railways up to date. Principal towns are given, but no hill work, so that, although somewhat rough in execution, the map is fairly clear.

GENERAL.**World.****Harmsworth.**

Harmsworth Atlas and Gazetteer. Parts 33 & 34. London: The Amalgamated Press, Limited, [1908]. *Price 7d. each part.*

These parts contain the following maps:—Part 33: Nos. 111-112, Persia and the Afghan Frontier; 151-152, Rhodesia and British Central Africa; 175-176, Central United States.—Part 34: Nos. 137-138, French North Africa and Morocco; 177-178, Western United States; 189-190, South America, North-West.

World.**Phillip.**

Phillip's series of Imperial Maps: The World, showing physical features. The Polar Regions. London: George Philip & Son, [1907]. *Price 2s. 6d. each.*

These are two well-executed sheets of maps, printed in colours. They are included in the last edition of Phillip's Imperial Atlas, but are also published separately at 2s. 6d. each, unmounted. The Polar Regions have been well brought up to date, and show the latest discoveries. They indicate by different colours, sea open all the year, extreme limit of drift-ice, and tundras. The other maps, showing physical phenomena, are also deserving of praise.

World.**St. Martin and Schrader.**

Atlas Universel de Géographie construit d'après les sources originales et les documents les plus récents, cartes, voyages, mémoires, travaux géodésiques, etc., avec un texte analytique. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. Sheet No. 74, États-Unis d'Amérique, Nord-Est. Paris: Hachette et Cie., 1908. *Presented by the Publisher.*

The first issued of a four-sheet map of the United States on the scale of 1 : 5,000,000, which will be published in this atlas. The latest materials appear to have been used in the compilation, which are mentioned in an accompanying sheet of text. Owing to the heavy and dark style in which the mountains are printed, the names in places can only be read with difficulty.

CHARTS.**Admiralty Charts.****Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during December, 1907. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
1202 m = 6·8		Scotland, west coast:—Lochs Diubaig, Grishornish, and Snizort Beg. 4s.
955 m = 0·85		Norway: Inner fiords between Rønde and Molde, including Volden, Stor, and Romsdals fiords. Plans.—Nes, Sæbo, Merok. 2s.
3636 m = 1·9		North America, east coast, Gulf of St. Lawrence:—Restigouche river. 2s.
2786 m = 3·0		North America, east coast, River St. Lawrence above Quebec:—North of Lanoraie to île Bouchard. 3s.
2787 m = 3·0		North America, east coast, River St. Lawrence above Quebec:—Île Bouchard to Boucherville. 3s.
2426 m = 3·0		British Columbia:—Port Simpson and adjacent anchorages. 3s.

New Plans and Plans added.

2114 m = { 5·7 11·5		Baltic entrance, The Kattegat, Plans added:—Skagen harbour, Østerby harbour. 3s.
2732 m = 2·9		Eastern archipelago, plans of anchorages in Bali Lombok, etc. Plan added:—St. Nicholas, Banjuwedan, and Pegametan bays. 2s.
991 m = 2·0		Japan, anchorages on the coast of Yezo island. Plan added:—Omu road. 2s.
1101 m = { 1·0 1·4		Mariana or Ladrone islands. New Plan:—Tanapag harbour. Plans added:—Maug islands, Assongsong island, Saigan island. 3s.

Charts Cancelled.

No.		Cancelled by	No.
1202	Scotland, west coast:—Loch Snizort.	New chart. Lochs Diubaig, Grishornish and Snizort Beg	1202
2805	Norway, sheet III.—Plans of Sæbo and Merok on this sheet.	New chart. Inner fiords between Rønde and Molde, including Volden, Stor and Romsdals fiords. Plans:—Nes, Sæbo, Merok	955
2806	Norway, sheet IV.—Plan of Nes on this sheet.		
1715	Gulf of St. Lawrence, Chaleur bay:—Plan of Dalhousie harbour on this sheet.	New chart. Restigouche river	3636

No.		Cancelled by	No.
2785	River St. Lawrence :— Lanoraie towards Contre- cœur.	New chart. North of Lanoraie to ile Bouchard . .	2786
2786	River St. Lawrence :— Contrecoeur to Repentigny.		
2787	River St. Lawrence :— Repentigny to Long point.	New chart. Ile Bouchard to Boucherville	2787
2426	British Columbia: Port Simpson and adjacent an- chorages.	New chart. Port Simpson and adjacent anchorages .	2426

(Charts that have received Important Corrections.

No. 1787, Ireland :—Wexford to Wicklow. 1772, Ireland, east coast :—Approaches to Wexford harbour. 8038, Norway :—Biørnsund to Kristiansund. 1971, Norway :—Approaches to Trondhjem, western sheet. 2368, Germany, north coast :—Jershoft to Rixhöft. 150, France :—Port and roadstead of Marseille. 1227, United States, east coast :—Boston bay and approaches. 2482, United States, east coast :—Fletcher's neck to Cape Cod. 1516, United States, east coast :—Boston harbour. 1097, Gulf of Mexico .—Caye Biscayne to lower Matcumbe bay. 3279, China, south coast :—Hong Kong waters east. 1602, China, north-east coast :—Approaches to the Yang-tse Kiang. 2924, Australia, east coast :—Cape Grafton to Hope islands. 473, Friendly islands :—Lifuka island, anchorage and approaches.
(*J. D. Potter, Agent.*)

Indian Ocean and Red Sea.

Meteorological Office.

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, February, 1908. London: Meteorological Office, 1908. *Price 6d. each. Presented by the Meteorological Office.*

North Atlantic and Mediterranean.

Meteorological Office.

Monthly meteorological charts of the North Atlantic and Mediterranean, February, 1908. London: Meteorological Office, 1908. *Price 6d. each. Presented by the Meteorological Office.*

North Atlantic.

U.S. Hydrographic Office.

Pilot chart of the North Atlantic Ocean, January and February, 1908. Washington: U.S. Hydrographic Office, 1908. *Presented by the U.S. Hydrographic Office.*

North Pacific.

U.S. Hydrographic Office.

Pilot chart of the North Pacific Ocean, February, 1908. Washington. U.S. Hydrographic Office, 1908. *Presented by the U.S. Hydrographic Office.*

Norway.

Norges Geografiske Opmaaling.

Kystkarter: Generalkart A1, Skagerrak. Scale 1: 350,000 or 1 inch to 5.5 stat. miles. Specialkarter. Scale 1: 50,000 or 1.3 inch to 1 stat. mile. B 40', Den Norske Kyst fra Froya til Gjesingen; B 55, Den Norske Kyst fra Rödö til Stott Christiania. Norges Geografiske Opmaaling, 1907. *Presented by the Norwegian Geographical Institute.*

PHOTOGRAPHS.

British Guiana.

Anderson.

Photograph of the Kaieteur fall, Potaro river, Essequibo, British Guiana, taken by C. Wilgress Anderson, Esq. *Presented by C. Wilgress Anderson, Esq.*

An excellent enlargement of this remarkable fall, measuring 12 inches × 14½ inches.

Himalayas.

Photograph of the Himalayas from Runikhot *Presented by Lieut. F. W. Parish, 60th Rifles.*

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

The Geographical Journal.

No. 4.

APRIL, 1908.

VOL. XXXI.

A MOUNTAINEERING EXPEDITION TO THE HIMALAYA OF GARHWAL.*

By T. G. LONGSTAFF, M.D.

It is probably from the snowy ranges of Garhwal that the words *Himaleh* and *Himalaya* take their origin, for it is this region which is connected with the most ancient traditions of the Indo-Aryan race. From the earliest annals of Hinduism we learn that these mountains have been regarded as of the greatest sanctity, and even at the present time more merit is to be obtained by the long and toilsome journey into the heart of this "Ábode of Snow" than to any other of the thousands of places of pilgrimage scattered through the length and breadth of India, with the possible exception of the sacred sites just across the border in Hundes. According to the *Mahabharata*, it was at *Bageswar*, in the Kumaon foothills, that *Siva* was married to *Parbati*, the "Mountain-born" daughter of *Himachal*. From her its highest summit takes the name of *Nanda Devi*, while the triple peak of *Trisul* is the "Trident" of *Siva* himself. In *Buddha's* time it formed part of the great kingdom of *Kosala*, which was afterwards absorbed into *Asoka's* empire, as is written on the "Picture Stone" at *Kalsi* in Lower Garhwal, the most perfect example extant of that emperor's rock-cut edicts. The pious *Hwen Thsang* records a visit to its shrines. A thousand years ago *Sankarachariya* suppressed Buddhism and restored the older Brahmanical religion, placing priests of his own Namburi clan from distant Malabar in *Kedarnath* and *Badrinath*. At the present day the *Rawals* of these two shrines are drawn from the same locality. Almost every natural feature of the country is connected with some event of ancient

* Read at the Royal Geographical Society, January 27, 1908. Map, p. 472.
No. IV.—APRIL, 1908.]

or mythical times. Thus, apart from other reasons of geographical position, it is not surprising to find that the great peaks are known by distinctive and widely recognized names of ancient origin, a condition of things by no means universal in other mountain regions. This region, too, is far more "alpine" in character than the icy solitudes of the Karakoram and Baltistan, and contains a rich and interesting flora and fauna.

The snowy ranges of British Garhwal, containing some forty triangulated peaks of over 20,000 feet, are roughly divisible into three groups. The first, representing an axis of elevation considerably to the south of the present water-parting, centres round the twin peaks of Nanda Devi, 25,660 and 24,379 feet—strictly speaking, the highest mountain within the British Empire. This group is most complicated and irregular in structure, but may be briefly described as being bounded on the west and north-west by the valleys of Alaknanda and Dhaoli rivers; on the north by the valley of the Girthi and the Milam peaks; on the east by the Milam valley; and on the south by the Pindar. Thus it will be seen that considerable portions of the eastern and southern slopes lie in Kumaon. The second group, a prolongation of the same axis of elevation, fills the angle formed by the valleys of the Alaknanda and the Dhaoli. Its highest peak, Kamet, 25,450 feet, is situated a mile to the south of the Tibetan frontier, in which country its northern slopes lie, the main axis of elevation thus articulating with the present water-parting, though it must not be forgotten that the streams rising from the Tibetan slopes flow into the Sutlej, and thus eventually reach India. In that corner of British territory to the east of the Kamet group, and to the north of the Nanda Devi group, lies a lofty but far less snowy area, whose physical and geological character approximates to that of the adjacent portions of Hundes. The third group really belongs to Tehri-Garhwal, and centres in the peaks around Gangotri; but the glaciers of its eastern slopes discharge their waters into the valley of the Alaknanda. The latter have never, as far as I can ascertain, been examined by Europeans, though the glaciers of Gangotri are fairly well known.

These steep-sided river valleys supply a number of natural routes by means of which it is relatively easy to penetrate into and beyond the barrier of the snows, and thus Garhwal has for many years been annually visited by British sportsmen, in addition to the thousands of natives from every part of India who have for generations performed the sacred pilgrimage, and to the Bhotias who trade over into the Tibetan territory of Hundes. Yet such is the inaccessibility of some of the lateral gorges, that in many places the glacier regions still remain untouched. The sportsman has no object in climbing above the snow-line, and it is only in very exceptional cases that the native can be induced to do so. Thus when they came to the snow-line, the officers of the Survey of India had

a problem of the greatest difficulty before them, which was further complicated by climatic conditions limiting their season to a few months at the outside. I have nothing but admiration for their work, and especially for that of Mr. E. C. Ryall, Assistant-Superintendent G.T.S., who carried out the Kumaon-Garhwal survey during the years 1874 to 1877. It is not surprising that there are errors in the delineation of the glacier regions, but it is surprising that men who had no training in what mountaineers call snow-craft should have gone where they have gone, and made such good maps of those parts of the country to which neither they nor the natives could gain personal access. And it is evident that they did not shirk difficulties, for it is casually mentioned in the Survey Report for 1874-75 that Mr. I. S. Pocock reached a height of 22,040 feet from the Mana valley, though there is no record of the actual spot reached.

In the first half of last century Traill and the Stracheys penetrated well above the snow-line. In the fifties the Schlagintweits visited the Milam glaciers and the Kamet group, where they reached a height of 22,259 feet on the Tibetan side. For many years Colonel E. Smyth, who selected Nain Sing and Kishen Sing for the Tibetan survey, made very high excursions in the course of his annual shooting trips. In 1883 Graham made the first purely mountaineering expedition amongst these snows, reaching heights of over 22,000 feet in the Nanda Devi group, and being the first to penetrate far into the mysterious valley of the Rishi Ganga. This expedition still constitutes the most successful ever recorded in the annals of Himalayan mountaineering, but its occurrence just a quarter of a century before public judgment in India was ripe for its appreciation, and Graham's own lamentable carelessness in writing the extremely condensed accounts* of his experiences, have combined to give an excuse for doubting the accuracy of his statements which has been seized upon by critics sometimes too much interested to be wholly impartial. As a rule the latter have passed over his first visit to Sikkim and his visit to Garhwal, confining themselves to disputing the ascent of Kabru during his second visit to Sikkim. But for the reputation of the Alpine Club—to which, be it noted, Graham never belonged—it is pleasant to record that he never lacked partisans amongst the most eminent and experienced of its members.

I first visited these mountains on my return journey from Tibet in 1905, details of which have already appeared in the *Geographical*† and *Alpine*‡ *Journals*. Last summer Major the Hon. C. G. Bruce, 5th Gurkha Rifles, Mr. A. L. Mumm, and myself, hoped to celebrate the Jubilee of the Alpine Club by attempting the ascent of Everest, or at

* *Proc. R.G.S.*, New Series, vol. 6; *Alpine Journal*, vol. 12; *Good Words*, 1885.

† *Geographical Journal*, vol. 29, pp. 201-211.

‡ *Alpine Journal*, vol. 23, pp. 202-228.

least the exploration of its unknown glaciers. In this scheme we received the most generous and cordial support from the President and Council of this Society. When we were peremptorily forbidden to enter Tibet by the Home Government, I was able to persuade my friends to join me in an expedition to Garhwal, the chief object of which would necessarily be mountain climbing rather than geographical exploration. This must be my excuse for the smallness of the geographical results which I am able to place before you. Nowadays there is only room for the specialist in the various branches of geographical investigation. The only specialty to which we can lay claim is snow-craft.

Besides ourselves, the party consisted of the guides, Alexis and Henri Brocherel, of Courmayeur, who had accompanied me on my previous expedition, and Moritz Inderbilen, of Zermatt, who had been Mumm's companion for over twenty years, and with him and Freshfield made a recent attempt on Ruwenzori. Owing to the great kindness of Colonel A. H. G. Kemball, of the 5th Gurkha Rifles, Bruce was able to bring from this regiment Subhadar Karbir Burathoki, Havildar Damar Sing Rana, and seven riflemen, mostly Magars and Gurungs. Damar Sing was a trained plane-tableer, had charge of the stores, and kept the accounts. Karbir counted as a guide, for he had climbed a good deal with Bruce in Kashmir and the Karakoram, and also with Sir Martin Conway in the Alps. The others, though accustomed to run about quite regardless of the accepted laws of gravity, were as yet ignorant of the higher mysteries of mountaineering. But to men trained in such a regiment this was of no consequence. They never failed us, they never complained, and they never lost their cheerfulness. Without them we could have done very little. They were superior to the best Garhwalis I have met, and even to the Bhotias, so I need hardly add that they bore no resemblance whatever to the Kumaoni or the down-country native.

Bruce also brought a single servant as cook, and undertook the entire organization of the commissariat and Gurkhas' outfit, while Mumm and I were still in England. We joined him with the guides at Almora on April 24 and got away on the 26th, crossing the Pindar river beyond Gwaldam on the 28th, after a 50-mile march through the Kumaon foothills.

We pushed on rapidly across the three intervening ranges of the middle hills, the zone of the pine, the oak, the rhododendron, and the fir. Snow was still lying on the ground in the upper forests, which are very beautiful, and from which most exquisite views of the high peaks to the east and north are obtained. Our route lay by Wan and Kanol to Ramni, where we picked up the stores which Bruce had sent on in charge of Karbir; then down to the Bireh Ganga and up the other side to Kaliaghat (Pana), passing above the remains of the Ghona lake formed by the great landslide of 1893; and so over the Kuari pass, 12,400 feet, to

LOWER END OF
TINTI NAI A



Photo A. L. Mumm.

Tapoban on the Dhaoli, which we reached on May 5, having covered another 50 miles. From the Kuari pass, still deep in snow, we saw the wonderful panorama of peaks stretching from beyond Badrinath right round to Dunagiri, and, thanks to the weather and an early start, we obtained some excellent photographs. On this occasion we required one hundred and fifty coolies to carry our baggage and the six months' supplies for the whole party which we were taking with us. Had it not been for the assistance of Mr. V. Stowell, I.C.S., the Deputy Commissioner for Garhwal, and to Bruce's forethought, we might have lost many valuable days on this part of our journey.

Our first objective was the Rishi valley, by means of which we hoped to find a practicable route for the attack of Trisul, 23,406 feet, the second highest peak of the Nanda Devi group, my visit in 1905 having shown that there was no practicable route on the south or west. This valley, though well wooded, and some 20 miles in length by 15 in breadth at its broadest, has never been permanently inhabited, but receives an annual two months' visit from the Tolma shepherds. The Rishi Ganga bursts into the Dhaoli at the hamlet of Rini, 6000 feet, but so narrow and precipitous is the gorge that Graham's party was the only one which had penetrated far up it. Mr. E. C. Ryall, in his report on the work of the assistant-surveyor who entered it in 1874, dwells on the "great exposure and privations in the Rishi Ganga valley, the survey of which is perhaps the most formidable undertaking in the whole range of the Himalayas yet accomplished."

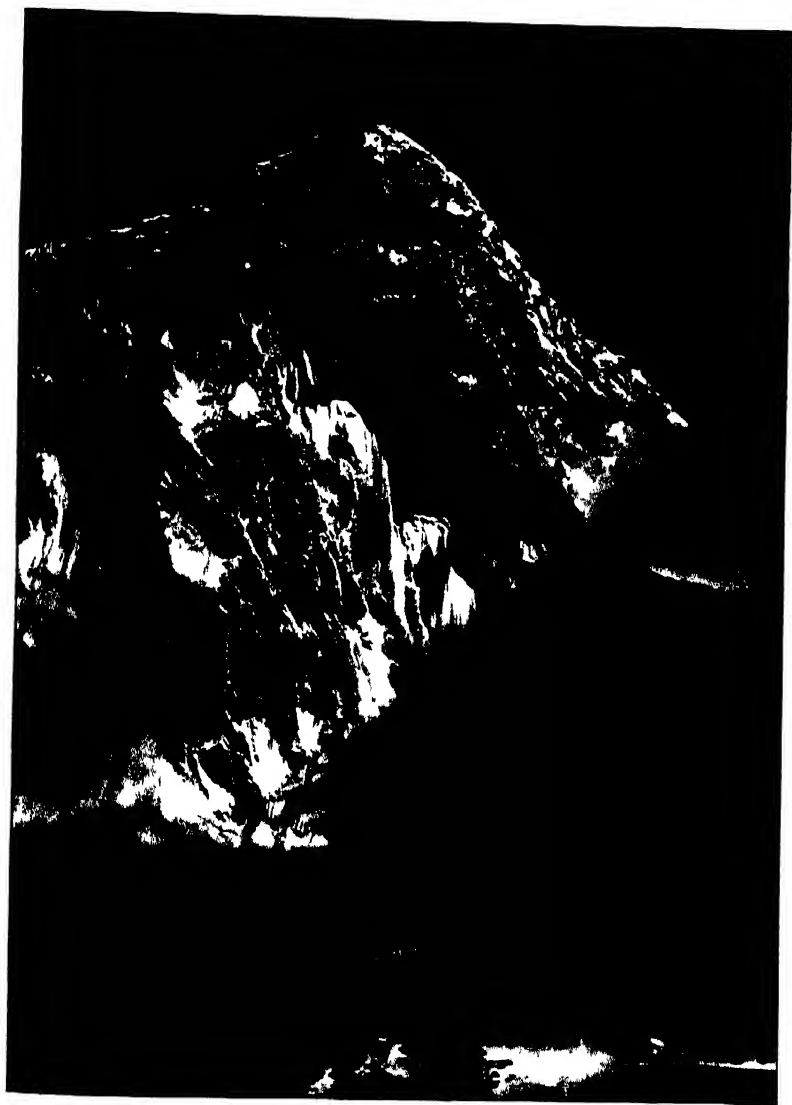
The name "Rishi" applies firstly to the seven "mindborn" sons of Brahma, now represented by the seven stars of the Great Bear, and to whom the Vedic hymns were revealed; secondly, it comes to mean an inspired solitary sage, or hermit, as near as I can translate it, and it is easy to understand that the mystery with which this valley is surrounded and the awe with which it is regarded led to a belief in the existence of such supernatural beings within its inaccessible recesses, and to the bestowal of the name. I had hoped to try the route by the valley for myself, but the river was swollen with the melting snows, and the local people declared that it was impossible for laden coolies to get along it. There is, however, a back door into the upper part of this valley, known to the Tolma shepherds, by which it has been entered by a single surveyor, a few native shikarris, and by three or four determined sportsmen, none, however, having got nearly as far as Graham with the exception of Mr. A. P. Davis, from whom I was able to get some idea of the topography. From Tapoban our heavy camp and stores were sent on to Surai Thota (*surai* = *Cupressus torulosa*) (7290 feet),* with some of the Gurkhas, to wait—as it turned out—until June 19. After spending several days on the slopes above the hamlet

* *Vide Notes.*

of Lata, and reconnoitring the cliffs along which our route must lie, we regretfully came to the conclusion that, owing to the depth of the snow, it was at present impossible to take coolies across with the necessary three weeks' supplies, so we decided to pass on for the present up the Dhaoli and Dunagiri valleys to the Bagini glacier beyond the village of Dunagiri, and to the north-east of the peak of that name, our main depôt still remaining at Surai Thota. On May 15 Bruce established our temporary base camp (12,850 feet) at the foot of the Bagini glacier, on a level with the last rhododendron and birch trees. According to the G.T.S. (? 1874), the Bagini glacier must have receded about half a mile; it now terminates at about 13,700 feet. The Dunagiri glacier of the G.T.S., flowing down from the north, does not now join it, but ends above a steep slope covered with moraine stuff close to the spot marked 14,237b on the G.T.S. I started Damar Sing with the plane-tableing, and we reconnoitred the upper part of the glacier basin together. As we had hoped, there seemed to be a strong probability that a mountaineering party could force their way into the Rishi valley, over the ridge between the G.T.S. peaks A₂₁, 22,516 feet, and Dunagiri, 23,184 feet, and get out lower down. We also hoped to learn something of the route to Trisul, for this was really unexplored country; so we decided on this course instead of trying a peak, of which there is a considerable choice hereabouts.

On May 20 the six Europeans, with Karbir, Kulbahadur, Buddhichand, and Dhan Lal, started up the Bagini glacier, taking eight coolies to carry loads. We camped (15,500 feet) on the right lateral moraine, sending the coolies back at once. Next morning (May 21) we pushed on up the Bagini glacier, and then turning almost due south, at our first plane-table station (16,140 feet), we continued along the main course of the glacier which, flowing from the direction of Dunagiri Parbat, sweeps round towards the north under the two peaks of A₂₁, 22,735 feet and 22,516 feet, locally known as Kalanka and Changabang respectively. The latter is the peak ascended by Graham in 1883, and named by him "Mount Monal." It is worth recording here that the bestowal of this name, after the *monal* pheasants that he saw "on its slopes," has been urged as a proof of Graham's unveracity. But how can any one imagine that he meant he saw them on the summit, or even above the snow-line? In his more detailed papers in *Good Words*, he explicitly states that he saw them between his camp on the banks of the Rishi and his final bivouac—a locality in which they abounded at the time of our visit. Changabang is the most superbly beautiful mountain I have ever seen, its north-west face, a sheer precipice of over 5000 feet, being composed of white granite with a pale pinkish tinge, so that it is at first mistaken for snow lying on the cliffs at an absolutely impossible angle.

All who were bound for the pass were heavily loaded, as we had



Dr. L. C. Longstaff, Photo

CHANGABANG (22,516 ft.) FROM THE BAGINI PASS.

to carry Primus stoves, petroleum, cooking-pots, tents, sleeping-bags, instruments, rifles and ammunition, a large supply of ropes, and provisions sufficient to last our party of eight for ten days. For, having got into the Rishi valley, we intended to get out of it some time. In the interval we must be self-supporting. The sun was so oppressive that after tramping over the snow for five hours we stopped, at 11 a.m., under the shade of some huge blocks which formed part of an irregular medial moraine (18,300 feet). Instead of making for the pass directly under Changabang, we had now decided to go right up to the head of this arm of the glacier, more directly under the great easterly spur of Dunagiri. Mumm was not going to cross the pass with us, and returned to the camp above Dunagiri with Inderbinnen and Damar Sing, leaving us a party of four Europeans and four Gurkhas. He rejoined us later at Surai Thota.

On May 22 we started at 4.30 a.m., but Bruce and I had very soon to stop with cold feet, and it was probably at this time that Karbir got his frost-bite. We had to rope over the last slopes, and the guides cut many steps. Our loads seemed to grow inordinately heavy, but at 10 a.m. we stood on the crest of the pass. Its height comes out at 20,100 feet, and the name Bagini pass would most naturally belong to it.

From the pass we looked down to a vast *firn*, shut in by snow-clad peaks, while 3000 feet above us on the west towered the icy crest of Dunagiri. But the descent of the south side looked so bad that we had to set about it at once. The Brocherels had brought a good supply of iron *pitons* from Courmayeur, and, by means of fixing these into cracks in the rocks and doubling ropes round them, we were able to lower ourselves and the loads down the snow-draped cliffs below us. It really was a difficult bit of mountaineering, the descent of about 1000 feet occupying over five hours, and the two Brocherels were quite in their element. This was a very fine performance on the part of the Gurkhas, and a striking testimony both to their inherently resolute character and to the excellence of their military training. Remember that they were called upon to perform a feat which was quite beyond the powers of any of the local men. As an instance of the value of local native evidence, I may mention that Mr. J. S. Ward, of the Rifle Brigade, told me that less than three months later our route was pointed out to him as lying over the spurs to the *west* of Dunagiri, along a shepherd's summer track. We had disappeared from the neighbourhood of their village and reappeared eight days later at Surai Thota. Obviously, then, we went by the only route they knew of!

We were very glad to camp about 4 p.m. on the snow-field directly at the south foot of the pass (18,800 feet). After a painfully cold night we got off at 6 a.m. on May 23, and proceeded down a huge snow-covered glacier in a south-easterly direction, with the twin peaks of

Nanda Devi showing over the ridge straight ahead of us, and then, turning a sharp corner in a south-westerly direction, leaving the magnificent cone of Changabang behind us. In six hours we reached the end of the glacier for which the name Rhamani or Arhamani was afterwards given us by a *shikarri* whom we took to the foot of the Trisuli Nala, from the slopes of which it is visible. He said that neither he nor any one else had ever been there, though Graham must have touched it, and I don't know that there is any authority for the name. We had fondly hoped to find ourselves on the great glaciers at the foot of Nanda Devi itself, but the G.T.S. is naturally very inaccurate here. The glacier ended in a steep tongue covered with a horribly unstable litter of moraine stuff.

We next came to an extraordinary gorge cut out by the glacier stream, which was often quite invisible, though very audible, under thick beds of hard snow. In one place we had to lower our loads on the rope, and follow ourselves in a similar manner. After food and a short rest, we broke out of the gorge to the right, climbed up the steep slopes on the west, and down again to the first patch of birch trees, where we camped at 6 p.m. (13,100 feet) amongst enormous boulders, which still held some snowdrifts from which we could get water. To the east towered the cliffs of Nanda Devi, too steep to hold the snow. South was the entrance to the Trisuli Nala, though the peak itself was invisible. Directly at our feet, more than 1000 feet below, lay the junction of the Rhamani and Rishi torrents.

We started late on May 24, after a most refreshing night, and skirted high up along the slopes that fall in one continuous sweep from the peak marked "Niti, No. 3, 17,056 feet" on the G.T.S., into the Rishi Ganga, here only 10,900 feet. There is thus a drop of over 6000 feet in a horizontal distance of 2 miles, while the slopes of the opposite south bank of the Rishi are very much steeper. After only a couple of hours of this work we saw some *bharhal* (*Ovis nabhura*) below us, and killed two, after an easy stalk. Much to the wrath of the guides, we decided to stay where we were and eat them, so we camped under an overhanging cliff, near a convenient supply of juniper bushes and snow. For May 25 I noted a "really terrific dry coasting along the slopes of Niti peak (No. 3, G.T.S.), at about 13,000 feet." We were all well loaded, and the strata being the wrong way, we were constantly toiling up steep slopes to avoid difficulties, only to find horrid cut-offs on the other side. This lasted from 7.30 a.m. to 5 p.m., by which time we had covered 2 miles in a straight line, when, after a particularly heart-breaking ascent, we came upon a most unexpected sight. In a deep lateral nala far below us was a thick forest of tall, straight pines surrounding a small grassy alp. For five days we had had to rely on snow for drinking purposes, and at only the two last camps had been able to get any wood, so this was a very welcome change. We afterwards found

that this was the summer pasture, named Dibrugheta (11,730 feet from six observations), to which the Tolma shepherds annually bring their flocks. The alp is less than half a mile south-south-west of the spot marked 14,710b on the G.T.S.; this is probably an error, though it appears to indicate the furthest point reached by the surveyor in this direction.

On May 26 we started rather late—at 7.45 a.m.—to make our way past the screen of bare cliffs, which, towering 2900 feet above us, completely shut in the *nala* on the west. We kept at first to the left bank of the stream, and rapidly gained height by following the crest of an old lateral moraine. Standing on this irrefutable witness of the former presence of glaciers, it was interesting to observe that this narrow and steep-sided glen was truly wedge-shaped in section, and now showed no signs of glacier activity, even on the exposed rock-faces opposite, other than the presence of the moraine itself. At the head of the glen, however, is a small hanging valley, the old glacier having doubtless here made a stand in the course of its retreat, and so inhibited the cutting-back action of the stream. Three weeks later, when *thar*-shooting, I followed the glen with great difficulty right down to the Rishi Ganga, and, from what I saw, came to the conclusion that Dibrugheta itself may represent a terminal moraine, but that this ancient glacier had never descended below that spot, unless we argue that the torrent may have obliterated all traces of it.

Crossing the torrent about $1\frac{1}{2}$ miles above Dibrugheta, we climbed up the steep grassy slopes, still snow-covered, and crossed the ridge at over 14,000 feet. Gentle snow-slopes led us on at 2 p.m. to three stone goat-pens half buried in snow. This was Durashi (13,230 feet from seven observations); it is close to the spot marked 12,950b on the G.T.S., so we knew we must be on the right track. The highest peak of the "Curtain" between Durashi and Dibrugheta was afterwards found to be 14,630 feet, and its lowest depression 14,100 feet. From this little peak, and from the top of a cliff a quarter of a mile to the west of our camp, we obtained most extraordinary views down a series of appalling precipices to the bed of Rishi Ganga far below us. From Lata peak, 12,624 feet, G.T.S., on the other side of which we had encamped a fortnight earlier, the drop to the river must be nearly 6000, and this in a horizontal distance of only three-quarters of a mile.

We still had to find the whereabouts of the goat track across the cliffs ahead of us, and when we left camp next morning (May 27), at 6.30 a.m. in cold wet mist and falling snow, we realized that we were in for some interesting work. We started up the slopes to the north-west and tried the cliffs in several places, but, owing to the mist, failed to hit off the route. However, after some good climbing, we found ourselves at 10 a.m. on the summit of a small peak (15,700 feet). We christened this Tolma peak, because we believed that if we went down the further

side we should reach the village of that name. It was snowing and blowing, and the descent of the steep snow gullies below us called for great care and all the usual precautions. Fortunately, the angle gradually eased off, and we were able to unrope and glissade down an old avalanche which took us right into the forest at the head of the Tolma glen. We then raced off down this densely wooded gorge, sometimes in the bed of the torrent itself, but more often creeping along the cliffs on its left bank, and so through Tolma village to our base camp at Surai Thota, thoroughly well satisfied with our eight days' expedition.

Bruce had, most unfortunately, damaged his knee during our passage down the Rishi valley, and it now became so painful that he was compelled to lie up. But the rains were approaching, and the assault on Trisul still to be made; so with his generously given consent we decided to leave him at the base camp at Surai Thota, with his servant and four of the Gurkhas. On May 31, Mumm and I set off with the three guides, Karbir, Damar Sing, Kulbahadur, Dhan Lal, Buddhichand, and also a young shikari, with twenty-three coolies to carry in our supplies for three weeks. We mounted the steep track to Tolma village, and then turned straight upwards into the forest past some magnificent deodars, one of which measured 41 feet in circumference 6 feet above the ground. The woods were full of *monal* pheasants, and we found a nest with six eggs in it. Early in the afternoon we camped on a pretty little alp known as Hyetui Kharak (11,500 feet).

We were up at 5.30 on June 1, but could not get the coolies off till 7 a.m. Soon after the tree limit (12,000 to 12,500 feet) had been passed, the guides commenced the arduous task of breaking a track through the snow for the coolies, who required the help of the rope to get round one particularly awkward corner. At 12.30 we reached the *col* (14,700 feet), and commenced the passage of the cliffs leading to Darashi. The guides had to cut every step of the way, while we and the Gurkhas helped the coolies over the worst bits. The goat track should have been clear by now, but, as I have said, the season was a late one, and every ledge was covered by a steep slope of snow. Fortunately no one slipped, and soon after 3 p.m. we reached our old quarters at Darashi. Next day we crossed the "Curtain" ridge, dropped down 2500 feet to the stream at its foot, and so reached Dibrugheta.

On June 3 the coolies got off before 7 a.m., as we had told them that this would be their last march. Crossing over an intervening spur, we struck down diagonally over very bad ground, below the slopes we had traversed on May 24 and 25, to the Rishi Ganga, making for a spot called Duti (10,900 feet). Here some huge boulders in the bed of the torrent made it easy to construct a temporary bridge, which we crossed about noon. We were now on the south side of the Rishi Ganga, and the opening of the Trisuli Nala—as we named it—was only a very short

distance further up the stream. But there is, of course, no sign of a track, and we had to climb up 1500 feet before we could turn east along the densely crowded thickets of rhododendron and birch which clothe the sides of the valley. However, soon after 3 p.m. we found a fairly good camping-place in the bed of the Trisuli Nala itself, amongst a tangle of birch trees, and just on a level with the last of the pines. This camp (11,600 feet) was to be our base for Trisul, so we paid off all but three of the coolies and sent them back to their homes, with instructions to return in three weeks if they felt inclined, but that we were quite independent of their services. This last statement, though true, was made merely to ensure their return.

On June 4 Damar Sing climbed up the steep crags on the right bank of the stream with the plane-table, while I went up the opposite slopes to get a look up the *nala*. Very soon I saw a glacier with a series of moraines on its left bank, which came sweeping into our *nala* from the south-west almost at a right angle. Soon after gaining this, about noon, I saw three *bharhal* crossing the ice, and shot a couple for food, which I think was allowable under the circumstances, and considering that only one sportsman, Mr. A. P. Davis, had ever been here. His camping-place was pointed out to me by the shikari, who called it Betatoli, which name I therefore attach to the glacier. It heads from the north-eastern slopes of the G. T. S. peak 20,842 feet, $4\frac{1}{2}$ miles north of Trisul. Its middle course is broken by a formidable ice-fall. Formerly the Trisuli glacier flowed into the Betatoli glacier from the south, and deflected the latter towards the north. Now that the Trisuli glacier has receded, the Betatoli has straightened itself out, leaving a series of lateral moraines along its left bank. Further, it has completely blocked up the Trisuli Nala, impinging against the cliffs of its eastern wall, and presenting to the south an almost perpendicular face of ice several hundred feet high, in the base of which the Trisuli torrent has carved out an ice-tunnel. The snout of the Betatoli descends just below the level of the birches and rhododendrons to about 12,400 feet, and showed no signs of recent recession.

It did not seem worth while to carry our base camp any higher, so we decided to leave Damar Sing in charge to carry on the plane-table survey, and to wait for Bruce with the shikari and the three coolies who had elected to remain with us. On June 5, I set off with Mumm, the three guides, Karbir, and the three other Gurkhas; we carried the lightest possible outfit—four Mummery tents weighing about 4 lbs. each, and eider-down sleeping-bags for the whole party. We followed the left bank of the stream straight up the Trisuli Nala, and then took to the left lateral moraine of the Betatoli glacier. After following this till the ice became less steep and broken, we crossed the glacier at right angles, scrambled up the moraine on the right bank, and dropped down into an unexpected little hollow on the far side. Its floor consisted of

old moraine heaps thickly carpeted with coarse grass and juniper scrub about 2 feet high. It was a pleasant and well-sheltered spot, obviously the last at which we could camp in any comfort, so, although it was only 11 a.m., and our altitude only 13,100 feet, we decided to stay here. Amongst ourselves we always called it "Juniper Camp."

After caching some tins and *bharhal* meat in a bed of snow, we started at 6 a.m. (June 6) up the moraine-covered slopes leading to the Trisuli glacier. Keeping well up the left bank of the Trisuli torrent, we reached the snout of the glacier at about 14,000 feet at 8 a.m. It is at present rapidly receding. I noticed that the black gneiss cliffs on the opposite (right) side of the glacier were seamed with beautiful veins of white, which I took for quartz. As we went on, the left lateral moraine grew more and more distinct, and soon its crest offered us an excellent path. At first it led us due south, but soon we began to bend round slightly to the south-west. Straight ahead were A_{20} , 22,490 feet, and A_{20} , 22,360 feet, and closing in our view up the glacier on the west were some high black cliffs festooned with icicles. Then we saw our moraine (left lateral) taking a sharp turn to the west, and, climbing up the mountain-side, disappear amongst snow and ice. At the same moment we saw the great gap between A_{20} and the middle peak of Trisul. I had reconnoitred its dangerous southern side from the Kurumtoli (Garhwali-Kail) glacier in 1905, when I pointed out the mistake in the G.T.S. Three months later on I was again to find myself on the south side of the range, and to discover that the Sukeram glacier was also wrongly delineated. Yet I must admit that the mountain grouping is here so complex, and the access to these glaciers so difficult, that the only wonder is that we have any maps of them at all.

We went on up to the last slope of the moraine that was free from snow and camped at 2.30 p.m., at a height of about 16,500 feet. This is the highest point at which I have seen any plants or grasses in this part of the Himalaya, though further north they extend very much higher. In front of us, as we looked towards the invisible summit of Trisul, was a magnificent ice-fall, and above that huge rolling wastes of desolate snow. Starting at 5.30 a.m. on June 7, we continued to mount in a westerly direction, having this ice-fall on our left hand, and a line of dark cliffs on our right. The slopes were steep at first, and our loads kept the pace down. On reaching the open snow-fields above, the sun became very trying, and I felt the exertion severely. About noon the slope steepened again, and a violent west wind began to blow, so at 2 p.m. we camped at an altitude which works out at 20,050 feet. The surface of the snow was whipped up and driven into and through our clothes apparently from every direction. We managed with great difficulty to persuade one of the Primus stoves to work, and Henri gave us all a hot drink. I turned in with Karbir, who watched over me like a nurse, although he was suffering considerable pain from the frost-bite

he had contracted on the Bagini glacier. We passed a cold uncomfortable night, owing to the violent wind and the snow which was driven into the tents. Next morning, June 8, the gale was still raging. The tents, though only 3 to 4-feet high, could hardly be kept standing, and it was quite impossible to make a start. As Inderbini was suffering from very severe headache, and the three Gurkhas were feeling the cold acutely, though without complaint, we decided to send them down to Juniper camp on the first sign of a lull, which came about noon. The rest of us stayed on in the hope that things might improve by the next morning. We could not stay outside the tents, so I passed the day in smoking and dragging out Karbir's reminiscences of war. He has been in forty affairs, and is great on bullet-wounds. He takes a sensible view of war, and fights to hurt. I fear Mumm had a very dull time alone in his tent. We could not even melt snow to drink, though the guides tried for more than an hour. The second night seemed worse than the first, and a lot of snow had driven into the tents by morning, so we literally tore ourselves up by the roots and struggled down through the bitter cold weather. We got out of the wind as soon as we neared the line of cliffs by the ice-fall, and leaving some things at our old camping place, we trudged back along the moraine to Juniper camp, which we reached at 2.30 p.m.

On June 10 we enjoyed a well-earned rest and the comforts of a fire, and although it snowed from 1 to 5 p.m., we felt very luxurious. Fearing for Karbir's frost-bitten foot, I tried to persuade him to give up the attempt, which we decided to renew on the morrow. But it was useless, as Bruce had warned me it would be, so we made some *bharal* skin covers for his boots, which we hoped would help to keep out the cold. Mumm had severe indigestion all night, and was so unwell in the morning that he decided to return to the camp in the Trisuli Nala. It was extremely hard lines, for he had had all the hard work and discomfort so far, and he stood high altitudes so well that he could certainly have reached the summit with us. So, to my great regret, we parted on June 11, with his most strict injunctions to get to the top somehow. I had with me Alexis and Henri Brocherel and Karbir. Dhan Lal and Buddhichand came with us for the day to carry my load and lighten that of the guides. Leaving Juniper camp at 6.20 a.m., we reached our moraine camp of June 6-7 very quickly at 10.50. All the morning the weather looked very arctic, but the absence of sun probably accounted for our excellent pace on the way up the moraine. At about 15,000 feet we put up several ram-chickor (*Tetraogallus tibetanus*), and saw a couple of very dark-coloured foxes. After much discussion with the guides, I had come to the conclusion that our best chance was to rush the peak from a lower camp, and not to tempt the wind again on the exposed snow-slopes higher up. Snow began to fall at noon, and soon afterwards we sent the Gurkhas back and pitched our two Mummery tents

at about 17,450 feet, under the shelter of the high cliffs already mentioned. We immediately set to work with the Primus stove, and after a long drink all round, we filled three large "thermos" bottles with cocoa and weak tea. In this way we hoped to provide a breakfast drink and enough liquid for the ascent, without having to waste several hours over snow-melting the next morning.

Snow continued to fall gently till the early hours. We tried to start (June 12) at 4 a.m., but I could not face the cold, which attacked my feet and hands before I could get my frozen boots on, although I had kept the latter inside my sleeping-bag all night. However, we started at 5.30 a.m., and as we carried only the very lightest loads we made very rapid progress. We reached our old upper camp (20,000 feet) by 10 a.m., where we remained half an hour to eat a small meal of raisins and plasmon biscuits, for we had all fully realized that it was most unwise for us to try and negotiate a heavy meal at such an altitude. Seeing signs of crevasses ahead, we put on the rope, Alexis leading, then Karbir, Henri, and myself. Then on we went up the snow-slopes, of continuous steepness but withal quite easy. My breathing was very rapid, and I felt very feeble, but I was securely tied on to the rope and could not escape. The *tourmentes* of wind-driven snow, to which this slope of the mountain seems very liable, were at times almost paralyzing in their intensity, yet I am sure that we bore the cold better than we should have borne extreme heat. At noon we found we had reached 21,000 feet, and here Alexis had to take off the small snow-shoes, with which he had been breaking a track through the crust of new snow, as the slope steepened again. I should mention that our route lay south-west by south all day after leaving the site of the upper camp. I began to doubt my capacity for maintaining the pace much longer, but Alexis and Karbir seemed quite happy, and Henri offered to pull on my rope as much as I liked, so I pocketed my pride and consented to this breach of the rules. Except for the briefest halts to recover my breath, we now rose rapidly and continuously, the slopes being at that particular angle of steepness which enables the climber to make height most rapidly, and all the peaks in sight sank below us, except Nanda Devi. As we neared the summit the bitter west wind again swooped down on us, rattling the icicles on our beards and moustaches. At 4 p.m. we emerged on to a flat-topped dome of snow. This forms the apex of the huge triangular snow-field which is set at a steep angle upon the north-east face of the mountain, and along the western edge of which we had climbed. Henri hailed it as the summit, and, driving his ice-axe into an incipient crack in the snow, planted the stick and square of canvas he had insisted on bringing up. But I was not yet satisfied, for just beyond us, across a dip in the ridge, was a most provoking cornice, which cut off the view to the south. Excitement made me lose all sense of fatigue, and I pushed on, the tail thus leading the head. Not knowing the size of the cornice,

that is the extent of its overhang, I had to keep well down on the western slope. The snow was frozen hard, and the crampons I was wearing bit well; however, the rest of the party were not wearing these "adventitious aids" that day, and I was ordered to cut steps. The distance was very short, and I soon crawled on to the cornice and looked over the edge, Henri hanging on to the rope in case of accidents. The first thing I noticed was that Henri had been quite right in insisting on the first peak being the highest, but I would not have missed the view down that astounding southern precipice for anything. Over the foothills was a dense copper-coloured haze—a dust-storm from the plains—but to the west I seemed to be gazing into endless space. I cannot describe that view, but the memory of it remains my most treasured possession.

The cold was very trying, and, turning back almost at once, we left the first summit at 4.30 p.m. I felt quite done up, but had no difficulty with my breathing as soon as I began to go downhill. Going very fast, we reached our camp under the cliffs at 7 p.m.; but perhaps my watch was fast, for it was so light that the men insisted on rolling up the tents and sleeping-bags, and carried everything down to our old camp on the moraine at 16,500 feet. That night my only desire was for sleep; I was neither hungry nor thirsty, though I had taken very little all day.

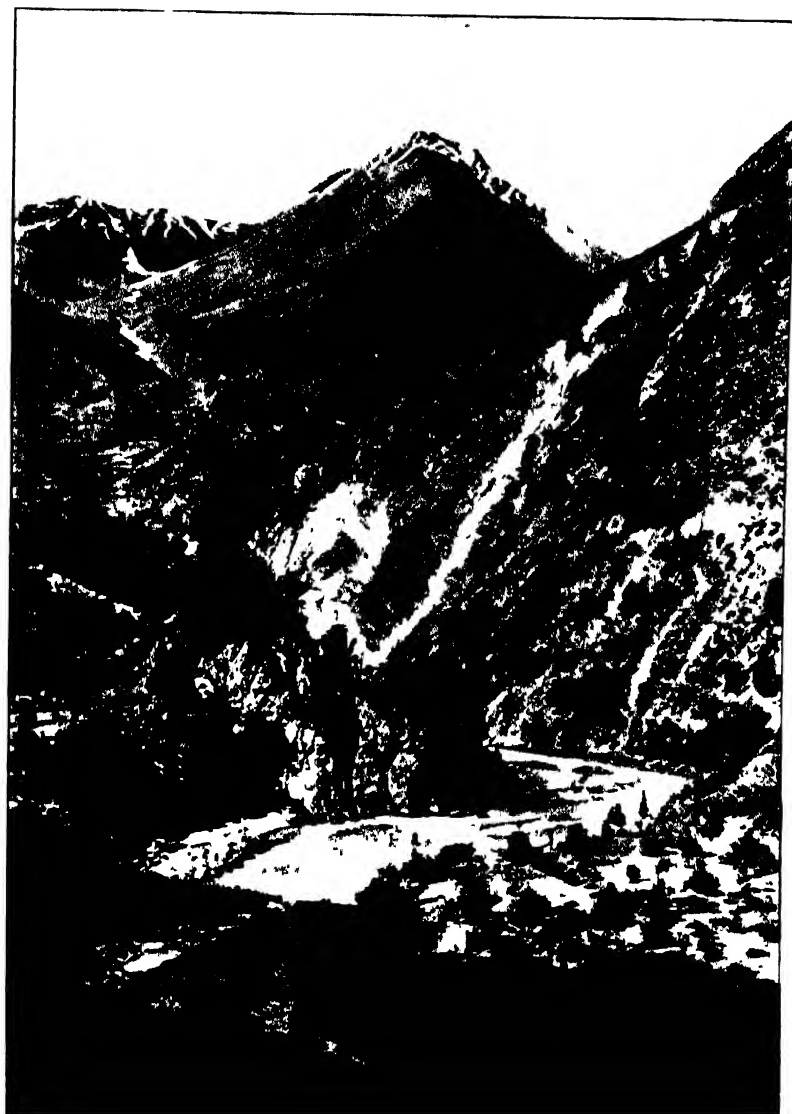
I hope I have made it plain that the two Brocherels, to whom all the credit of the ascent is due, and Karbir showed no signs of distress during the climb. We ascended from a camp at 17,450 feet to the summit, 23,406 feet—that is to say 6000 feet, in ten hours. Graham estimated his highest camp on Kabru at 18,500 feet, and reached the summit, 24,000 feet—an ascent of 5500 feet—in a little over nine hours. In each case this gives a rate of approximately 600 feet an hour. Turning to the Alps, the best instance I can remember for comparison is the ascent of Mont Blanc, 15,781 feet from the Dome Hut 10,499 feet on the Italian side. I have twice performed this ascent of 5282 feet in five and a half hours, which gives a rate of 960 feet an hour. In addition to this diminution of progress, I am distinctly conscious of both mental and physical lassitude at very great altitudes; but I have now been to 20,000 feet and over on about ten occasions, and slept at least three nights at such altitudes, and my experience confirms me in the belief that the effect of low atmospheric pressure depends on the strength and condition of the climber much more than on the actual altitude he attains.* I also believe that the idea of acclimatization to low pressures is fallacious, for in my experience the effects are cumulative; and it was this consideration which finally decided me to rush the peak from a comparatively low camp.

* *Vide 'Mountain Sickness and its Probable Causes' By the writer*

Next morning (June 13) Alexis and I proceeded up the level snow-covered surface of the Trisuli glacier for one and a half hours; while Henri and Karbir started back down the glacier with heavy loads. Ahead of us lay the Trisul Gap, as I would name it, for, having never been crossed, it can hardly be called a pass. It has the appearance of being less than 18,000 feet in altitude, and is situated in the great ridge which runs from the middle peak of Trisul (? about 22,000 feet) in an easterly direction through the peaks A₂ and A₃ of the G.T.S. The map therefore misplaces this water-parting between the Pindar and the Rishi by about 2 miles, showing the ridge as articulating with the highest (northernmost) peak of Trisul.

Returning down the Trisuli glacier, we redistributed our loads at Juniper camp, which we had looked on as our home since June 5, and proceeded across the Betatoli glacier and down to our base camp at the mouth of the Trisuli Nala. Here we were welcomed by Bruce and Mumm, the former having sufficiently recovered to come over into the Rishi valley, but being now down with fever, so that it was impossible for him to attempt to repeat the ascent of Trisul. It will always be a source of great regret to me that neither of my companions were able to share in this ascent. We all worked together during the expedition, but I think Bruce worked harder than the rest; certainly Mumm and I feel that we owe him a great debt of gratitude for the trouble he took over organization both before and during the journey. The ascent of Trisul is quite easy from the technical point of view, but demands so much mechanical endurance that no one who is not in perfect health can hope to achieve it.

On June 15 Bruce and Mumm started back across the Rishi valley with the guides and Gurkhas, all carrying double loads. On the 14th I went off with Kulbahadur and Pahal Sing in an endeavour to force our way right up the Rishi valley to the foot of Nanda Devi, taking four days' food with us. With considerable difficulty we reached the junction of the Arhamani torrent with the Rishi Ganga, where we crossed the latter to the north bank by a snow-bridge (11,790 feet), as we could get no further along the south bank, and the current was too strong for wading. Here we camped under an overhanging rock amongst the birch trees. Next morning we climbed straight up to about 13,500 feet, and in the intervening 1700 feet of cliffs between this and the Rishi Ganga saw no practicable route up the valley, though we obtained a most wonderful view of Nanda Devi. I think that we were just beyond Graham's furthest point in this direction. We could see no sign of a glacier filling the head of the Rishi valley, such as is shown on the G.T.S. maps, and Damar Sing reported from his observations from the ridge which forms the eastern boundary of the Trisuli Nala, that the glaciers from the north and south of Nanda Devi do not join each other at the western base of that peak.



THE DHAOLI RIVER ABOVE MALARI

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Crossing back to the south bank we returned down the Rishi valley and rejoined the others at Duti on the evening of the 15th. On June 16 we all pushed on to Dibrugheta, where we were relieved of our loads by the coolies, who came in on the following day and carried them up to Durashi. On June 18 we reached our base camp in the Dhaoli valley at Surai Thota.

Our next objective was Kamet, so we had to move our base camp up the Dhaoli valley towards Niti. The encamping ground named Juma Gwar is undoubtedly situated on the old moraine of the Juma glacier, and there are several erratic boulders stranded on the hillsides to the west. Between Juma Gwar and the village of Malari the track is generally carried several hundreds of feet above the Dhaoli river, through a magnificent gorge, and skirts several stretches of water-worn rock cut into great concave cups and hollows, still quite regular and smooth: in one place the path crosses an open-sided pot-hole about 400 or 500 feet above the present level of the river. All these contours have been cut by water flowing in the same direction as the present stream, and not by lateral tributary torrents. It is obvious, then, that the river has either greatly deepened its bed, or that its erosive action has kept pace with the uplift of that bed. From the size of these water markings, I concluded that the river must formerly have carried a greater volume of water than it does now. They occur on a section of the river only 30 miles below its present source, and just on that section which pierces the main axis of elevation. Similar phenomena are of frequent occurrence in the valleys of many southward-flowing Himalayan rivers, and have been explained as due to increased erosion, cutting back, and capture, consequent on the copious rainfall and steeper slopes of the southern side. But it is just the area drained by the last 30 miles of the Dhaoli which has a much smaller rainfall than the rest of Garhwal. In this instance we seem to find support for the theory propounded by Medlicott, of an earlier drainage system which has continued to drain an area originally to the north of the main axis of elevation. Is it impossible to modify both these theories and to suggest that before the Himalayan barrier reached its present proportions, the rainfall above Malari and Niti was greater than it is now, thus enabling a larger river than exists at present to cut down and so keep pace with the uplift of its bed? From what I saw in the neighbouring parts of Tibet two years ago, I am quite convinced that the rainfall there was formerly much greater than at present.

At Malari, 10,011 feet G.T.S., an important Bhotia * summer village, we are opposite the mouth of the Girithi valley; the country to the north and east is beginning to assume a Tibetan character, the skies are

* For an account of these very interesting people, *vide* C. A. Sherring's paper in *Mem. As. Soc. Bengal*, 1, p 8

bluer and the mountains barer, both of vegetation and snow, though there are some very fine deodars close to the village. Here I was greeted by a Bhotia whom I had met two years previously at Shibohilam, in Hundes. I had there engaged yaks from the Dzongpön of Daba to take my belongings back into India. To my surprise, the Tibetan in charge bolted in the night with the yaks at the foot of the Chor Hoti pass, after having taken me all through the Dakka hills and over the Shalshal pass into British territory. I had no difficulty in reaching Niti, but, as a matter of form, wrote a note in English complaining to the Dzongpön. Months afterwards I had received a postal order for Rs.8 for which I could never account. Now the Bhotia informed me that the Dzongpön had sent this sum to me as the balance due from the full yak hire I had already paid, and which had been forfeited owing to the flight of the Tibetan driver. This is a striking example, not only of Tibetan honesty, but of the friendliness with which English people are regarded by Tibetan officials. Doubtless the epidemic of political aloofness which is at present so popular in this country will lose for us the good impression that we have made, for the position which we have taken up over the Tibetan question will inevitably be attributed to fear.

From Malari we sent our baggage up the valley through Gamsali village to Timor Shim, the encamping ground below the large Bhotia village of Niti, 11,857 feet, while we crossed the easy Kurkuti Dhar, 15,064 feet, getting fine views of the Hoti peaks and up the Gamsali glen. The descent to camp of about 3500 feet was very easily accomplished in an hour, thanks to several glissades, for we were entering a country of gentler contours and of very different conformation to the ranges which form the main axis of elevation.

At last we were able to persuade Karbir to pay some attention to his frost-bitten foot, from which he was now suffering acute pain. Leaving him in charge of the base camp at Timor Shim, we started again along the Niti track with eighteen *jhos* and fourteen coolies. The Dhaoli valley above Niti is of considerable geological interest, for the river follows the course of the great fault between the crystalline rocks of the main axis (Nanda Devi, Trisul, Dunagiri, and Kamet range) and the younger sedimentary beds which are developed along the Tibetan frontier. On the gneiss of the right bank are the last outlying pines; on the left there is only scrub, with the last rhododendron and birch trees at Goting E.G. (12,490 feet) where we camped on June 26. The view up the valley and the actual surroundings at this spot are strikingly reminiscent of the analogous solitudes across the Tibetan frontier. The *bharhal*, the marmot (*A. Himalayanus*), the red-billed chough (*G. eremita*), and the snow-pigeon (*C. leuconota*) seem to be the chief permanent inhabitants. The very air is now much drier and clearer and the sun more powerful, and we could daily watch the white clouds roll up from the south-west only to dissolve above our heads. On

June 27 we crossed the Dhaoli by a natural bridge. Above this the valley was remarkable by reason of the triple tier of gravel beaches raised one above the other on the left bank of the river. On turning up the Raikana Nala which still follows the course of the great fault to which I have alluded, we deserted the track to the Niti pass. But it was interesting to note that the Raikana river possessed a greater volume of water than the Dhaoli, although the latter has received the waters of the Ganes Ganga. In this region the rainfall diminishes with every step towards the north.

On June 27 we made our first camp in the Raikana Nala, at a place called Kali Kharak (13,600 feet). We were on the left bank of the Raikana river, which has here cut a deep gorge for itself through moraine stuff along the line of the great fault. Up the valley to the north-west is a huge moraine, marked on the G.T.S. as a series of hills. It is, however, a true terminal moraine, the greater part of which is still lying on ice which certainly descends below 15,000 feet. Immediately at its foot is an irregular plain, scattered over with huge moraine blocks and supporting a scanty growth of juniper and grass: this is called Raikana Kharak (14,200 feet), and is occasionally used as a pasturage for yaks and *jhobus* by the Niti Bhotias. Here I saw a rare and beautiful little bird, *Erythacus pectoralis*, a near relative of the Arctic "bluethroat." Crossing this, the next morning we ascended the moraine, but, owing to the badness of the going, had to stop at 11 a.m. and send the *jhobus* back to their scanty pastures at Raikana Kharak. Our camp was pitched at 15,350 feet, on a level patch of moraine-stuff adjoining the ice on the left bank of the glacier, and directly below Chango, 20,216 feet. We were able to obtain wood from the juniper bushes at Raikana Kharak.

On June 29 I proceeded up the left bank of the main Raikana glacier with the two Brocherels. We passed several fine glacial pools, which might almost be accorded the title of *marjelen* lakes, the larger ones containing small floating bergs. In three hours we reached a height of about 16,300 feet, the glacier being very rough and crevassed. To the north-north-west was a snow-pass leading into Tibet, and on this side easy of access. To the west we were looking straight up a glacier, which leads to what I take to be Strachey's 24,670-foot peak, about a mile to the north-east of Kamet itself, and which I had seen from Gurla Mandhata, 100 miles to the east in 1905. Owing to inaccuracies in the map, we had overshot our mark, which was the glacier leading to Kamet itself. After watching some *bharhal* feeding on the stony slopes opposite at over 16,000 feet, we turned back crossing over to the right bank of the glacier, and skirting round a great buttress so as to reach the glacier which flows from the actual south-east base of Kamet, and which, for convenience, I shall call the Kamet glacier. We had to climb high above some bad cliffs on the buttress, but eventually dropped down on

to the Kamet glacier and continued up it to a height of about 16,300 feet. Here we saw enough to show us that we were on the only possible route by which our peak could be attacked on this side, though we could not reconcile the map with what we saw before us. Descending the Kamet glacier, we found that it united with the Raikana glacier, its extremely broken and moraine-covered surface having doubtless deceived the surveyors into thinking that the two ice-streams did not join one another. We reached our camp late in the evening, after a very long and fatiguing day.

On June 30 we started to reconnoitre Kamet, taking with us the two Brocherels, six Gurkhas, and ten coolies. Crossing the Raikana glacier, we went up the Kamet glacier, and, after some rough walking, made a camp at 16,800 feet on the left lateral moraine, where we found some big boulders on a grassy slope, which gave our camp a very luxurious air. As usual, we sent the coolies back at once. On July 1 we did not start till 6.30 a.m.; to follow the glacier further would have been very risky, owing to the dangerous hanging glaciers which drape the northern slopes of Mana peak (No. 1, 23,862 feet, G.T.S.), so we turned sharply to the north-west up a very steep moraine-slope. This landed us on a glacier of the secondary order which flows down a typical hanging valley. Our surroundings gave a striking example of the conservative effects of ice. The small glacier stream emerged from the snout of the glacier at an altitude of about 17,400 feet. The ice-covering was obviously checking the development of the valley, in particular, inhibiting the back cutting by the stream, which, as I have remarked, is but a small one, for the higher the ice the less is the melting.

Heavy clouds were blowing over the ridge from the south-west, but the echo from the cliffs on our right kept us straight. We pushed on over ever steepening snow-slopes, and at 1.30 p.m. reached the crest of the ridge. The Watkin observation gives a height of 20,180 feet, worked out in the way I have indicated in the notes. But the camp was fixed, as usual, by hypsometer, and using this as a lower station, the reading would be 20,870 feet. I think this tends to show that the other altitudes are not overestimated. The clouds cleared somewhat, and we saw directly below us the avalanche-swept Kamet glacier winding down from the foot of that great peak (25,443 feet G.T.S.). But we were completely cut off from it. Worse still, we never got a complete view of its stupendous south-east face, which falls in a succession of red precipices more than 7000 feet to the glacier below. We had carried the plane-table up with us, but with all the clouds about it was useless to set it up; indeed, the cold wind alone was sufficient to drive us down after we had waited for three-quarters of an hour in hopes of a clear view. We had seen enough to know that there was no practicable route by which the peak might be attacked on this (eastern) side. The

upper Kamet glacier is horribly dangerous, lying in so narrow a gorge that it would be quite impossible to escape from the ice avalanches which constantly fall on to it. During the descent we again noticed how the clouds were dissipated as the dry air of Tibet was approached, and over the Chango ridge we obtained the most wondrous glimpses of that part of Tibet in which it had been my good fortune to wander two years previously.

Next day we returned down the Kamet glacier and crossed the Raikana glacier to our camp. One of the largest of the glacier lakes had emptied itself since we had passed it three days earlier.

As we considered it useless to attempt Kamet from the east, we now decided to cross the main range to Badrinath, in the valley of the Alaknanda. Our heavy baggage would have to go round by Joshimath, but by using a snow pass known to the natives, we hoped to be able to cross with sufficient tents and supplies to keep us till our heavy camp could arrive. So we all returned to Niti, and on July 4 had the whole of our effects carried down through the wonderful Niti gorge to the encamping ground (11,190 feet) opposite the village of Gamsali, on the right bank of the Dhaoli river.

On piercing the narrow gorge below Niti, where it bends upon itself at an angle of 45° , the Dhaoli cuts its way deeply through a vast bed of hard silicious mud and great angular boulders, which extends for 3 or 4 miles down the valley towards Malari, and forms a more or less level floor, about 2 miles wide at its broadest, between the steep gneiss cliffs which bound the valley on the east and west. I cannot escape the conclusion that, though portions of this bed may be due to rock-falls from above, a considerable part of it represents a moraine left by the recession of the huge glacier system which still fills the head of the Gamsali glen. But I feel still more certain that no glacier ever pushed through the Niti gorge from above, though there are water-marks there high above the present level of the stream, showing how it has deepened its bed.

On July 7 we started up the Gamsali valley with about twenty Bhotia coolies, and soon found ourselves amongst a chaos of huge rocks. These are probably the result of rock-falls overlaying moraine stuff. The valley is shut in on either side by the most glorious gneiss cliffs, the general effect produced being similar to that of the Vale of Lauterbrunnen carved on a sublime scale, but with the forests absent. Further on we came to an unmistakable terminal moraine, its summit raised above the valley floor immediately ahead. At this time of year it was a veritable garden of flowers, and afforded excellent pasturage for the Gamsali flocks. It can only have been formed at a time when the snout of its parent glacier was almost stationary, or only retreating very, very slowly. After this the glacier must have retreated with great rapidity back to its present point of termination (13,000 feet),

about which it has made another stand, as evidenced by the formation and character of its moraines. The intermediate distance is a flat waste of stones, through which the stream wanders in many channels, but the lateral moraines are still well marked where side streams and avalanches have not destroyed them. The secondary glaciers, coming down from the G.T.S. peak, 19,815 feet, formerly joined the main glacier, and even now come down very much lower than is indicated on the maps. From the largest a stream of stone avalanches falls, both day and night, over a steep cliff on to the moraine of the main (Baike) glacier below. This is an example of how the *recession* of a glacier might in particular circumstances close a route, for at the time when this secondary glacier joined the main ice-stream such rock-falls could not occur. Though I have not visited the Ralam pass myself, I believe, from what I have heard from natives, that this is the probable explanation of the closing of that old route from Johar into Darma.

We camped on July 7 at a spot called Thur Udiar (13,000 feet), close to the snout of the main glacier, to which the Gamsali people gave the name of Baike *gal*. Next day we followed the left lateral moraine for two and a half hours, and camped on a flat shelf behind it called Eri Udiar (Cold Cave) (14,690 feet). Here were the last of the juniper bushes; the fact that they had not all been cut for fuel long ago in itself showing how rarely the natives visit this spot. Facing us was a magnificent ice-fall, flowing down the slopes of G.T.S. peak, 21,198 feet, in a north-easterly direction, while from the steep slopes above our camp there was a splendid view of Rataban, 20,094 feet, and also of the beautiful little glacier lake at the foot of the former peak. The pass by which we meant to cross the range lay between these two fine mountains, but was completely hidden behind a subsidiary spur of the 21,198-foot peak. It was crossed in 1862 by Colonel Edmund Smyth,* and we were told later by the priests at Badrinath that one of the Stracheys had also crossed it.

I returned for letters to Gamsali with Bruce, who had to make arrangements for sending Karbir round by the valley route with our heavy camp. On the 9th and 10th, in spite of very unsettled weather, Mumm and Inderbuen explored the upper Baike glacier towards the Mana peak (G.T.S., No. 1, 23,862 feet), finding most unexpected indications of a pass. I regret we did not follow this up by attempting to get to Mana by this new route. On July 11 we all assembled once more at Eri Udiar, and started at 7 a.m. next morning to cross the Bhyundar Khanta, taking about twenty lightly laden coolies with us. We reached the top of the pass without difficulty at noon, and saw three *bharha* above us. I found the altitude to be only 16,700 feet. The view to the



RATABAN (20,084 ft.) FROM THE SLOPES ABOVE ERI UDIAR.

A. L. Mawson, Photo

south-west into the green Bhyundar valley was very fine, and a great contrast to the stony desolation of the north. Due south rose Gauri Parbat, 21,747 feet, well named the "Brilliant peak," and over its shoulder we could see the top of Hathi Parbat, 22,141 feet, named after its resemblance to the body of a reclining elephant. We were standing upon more than a mere water-parting, for this is the screen which precipitates so much of the rain borne by the south-west monsoon, and accounts for the higher snow-line (17,000 to 18,000 feet) found to the north and east, and for the very different flora and fauna which are found on that side. The same state of things prevails on the north and south sides respectively of the Nanda Devi group: on the south the snow-line is about 16,000 feet, the glaciers descend to 12,000 feet, and the forests are very extensive; while on the north the forests are scanty or absent, and end well below the terminations of the glaciers, which, though frequently greater in volume, do not descend so low (13,000 to 14,000 feet); but, owing to its complicated orography, there is no spot comparable to the Bhyundar Khanta, where the two different landscapes are brought into the same immediate field of view.

Though the snow-slopes on the north are much crevassed, and those on the south are steep and require some care, this pass is not at all difficult as compared with the Alpine standard. The G.T.S. is inaccurate on both sides, but especially on the south, where the number and extent of the glaciers is greatly underrated, one of those left out being some 6 miles in length. Still, the map was of the greatest use to us, and would enable a mountaineer to plan routes with considerable confidence.

The descent is broken by a cirque of cliffs over which the ice of the G.T.S. Thiapap-ka-bank (Garhwali Bhyundar) glacier tumbles, but we avoided them by a long traverse to the west on steep snow, and, scrambling down a rock gully, reached the dry glacier itself. Gradually we edged off the glacier towards its high right lateral moraine. We now saw the full face of Hathi Parbat, from the western base of which a large glacier rises. At its head is a pass, practicable on this side at least, which, according to the G.T.S., would lead over on to the Juma glacier. It joins the Thiapap-ka-bank (Bhyundar) glacier about a mile below what is shown as its termination on the G.T.S. Opposite this junction we camped, at 3.30 p.m. There is plenty of juniper and good shelter amongst the boulders, with water not far off, and the place is known as Shem Kharak (12,800 feet). We did not see the lake marked as Lakpal-ka-kund on the G.T.S.

We continued down the moraine next morning (July 13) for three-quarters of an hour, when we reached the snout of the Bhyundar glacier at an altitude of 12,000 feet. Our route now lay across the most luxuriant meadows I have met with in this part of the Himalaya. We waded through flowers up to our waists—ferns, yellow lilies and anemones, green fritillaries, purple monkshood, and in the drier spots a

beautiful blue dwarf iris, and white and red wild strawberries, with forget-me-nots and large yellow king-cups by the streams. Swallow-tailed butterflies and small birds were flitting about us on all sides. Altogether we found its charm so irresistible that we camped at 10.30 a.m. This spot was called Bhamini Daur by our coolies. It is situated at an altitude of 11,650 feet, just where the Bhyundar river, which has been flowing in a south-westerly direction, makes a sudden sharp turn to the south into the jaws of an extraordinarily abrupt defile. We were told, probably incorrectly, that this defile is quite impassable lower down. A fortnight later we passed the spot where it enters the Vishnu (Alaknanda) river, a mile below Pandukeswar.

We left this camp at 8 a.m. on July 14, going due west towards an obvious pass. After scrambling up a very steep grass slope beside a fine waterfall, we emerged into a hanging valley strewn with moraine heaps, and into the upper (north-west) part of which a small glacier descends. Passing below its snout, up easy grass slopes, we reached the pass known as the Khanta Khal at 11 a.m. The hypsometer gave the altitude as 14,750 feet and the corrected Watkin aneroid as 14,500 feet. I obtained a fine five-plate panorama of the peaks and glaciers to the north and east, which has been utilized for our map. To the west clouds somewhat interfered with the view, but the wonderful snowy spike of Nalikhanta, 21,713 feet, dominating Badrinath, stood out glittering above them. We descended through a wild glen to Hanuman Chatti (8500 feet), the descent of 6000 feet in $2\frac{1}{4}$ miles being accomplished in less than three hours. The beds of avalanche snow in the nala extended almost down to the village, and we had some splendid *glissades* whenever we could get down into it.

At Hanuman Chatti we were on the great pilgrim route to Badrinath, which we passed through on July 15, pitching our camp at Mana village the same day. While waiting for Karbir and our heavy camp to come up, Munm visited the junction of Bhagat Kharak, and Satopanth glaciers from which the sacred Alaknanda river issues, while I pushed on up to Mana pass, and reconnoitred the western approaches to Kamet. I suggest that the name Sarasutti, given to the main river above Mana by the G.T.S., is really Saraswati, a name of great historical interest and of very ancient origin.

Just as the Garbyang Bhotias trade with Purang (Taklakhot) over the Lipu Lekh, the Milam Bhotias with Gyanema over the Untadhura, and the Niti Bhotias with Daba over the Niti pass, so do the Mana Bhotias carry on the trade with Tsaprang and Toling (Totlingmath) over the Mana or Chirbattia pass. The gradients are easy, but the going is extremely bad for yaks, ponies, or sheep, all of which are used for transport. The upper half of the route lies over a chaos of unstable rocks of all shapes and sizes. The distance from the highest village, Mana, to the pass is 25 miles. This can be done by men in four days,

but pack-sheep take at least a week. The chief encamping grounds are—

			Hypsometer	Corrected Watkin aneroid.	G.T.S
Ghastoli	...	..	13,200	13,100	—
Balbala	...	...	15,500	15,250	—
Rata Kona	..	...	15,950	—	16,003b
Jagrau	...	..	17,550	17,150	—
Mana pass	..	...	—	18,088	17,890b

On July 18 I made a short reconnaissance towards Kamet. Leaving Ghastoli E. G. at 6.45 a.m., we proceeded up the valley past Khaiam E. G. for an hour and a half, and then turned east up into a hanging valley over a steep moraine-strewn slope. The ice of what might fitly be named the Khaiam glacier descends to 15,400 feet. Ascending this glacier for some little distance, we struck up on to the ridge to the south, at 2 p.m. reaching the summit of one of its peaks at an altitude of 17,550 feet. To the west was the Bidum glacier, and to east-north-east Kamet itself. The Khaiam glacier probably forms the most practicable route to the attack of this peak. To the south was the Ghastoli peak, marked as 18,002 feet on the G.T.S. We certainly seemed to be higher, and I think the altitude is wrongly marked. We had a very good climb down the rocks on the reverse side of the ridge to the glacier which enters the Mana valley just above Ghastoli, and to which I would attach that name. The ice descends to about 15,000 feet.

No European seems to have visited the Mana pass since the visit of the surveyor, Mr. I. S. Pocock, in 1874, during which visit, as I have already mentioned, he reached the great altitude of 22,040 feet. The survey appeared to me to have been exceedingly well done.

Game is extremely scarce, though grass and flowers are to be found at great altitudes. On the pass itself, at 18,000 feet, I found *Primula minutissima*, *Parrya lanuginosa*, and a *draba*,* all in flower. The gneiss and crystalline schists extend up to the water-parting, but the landscape on the Tibetan side suggests a later formation. The Abijugan glacier appeared at the time of my visit to lie exactly across the pass, and to discharge streams both towards the Sutlej and the Alaknanda.

From the number and extent of the glaciers on this part of the Tibetan frontier, I concluded that the rainfall must be considerable, and certainly greater than it is further east.

During the whole of the week I spent in the upper Mana valley I felt the effects of the high altitude severely, though the mythical symptoms (hæmorrhages, etc.) of that dread disease, mountain sickness,

* For these identifications I have to thank Mr Edmund Baker, of the British Museum

were absent. The guides and Gurkhas showed no weakening of their powers, though we had a hard time. We experienced very bad weather, with high winds and frequent snowstorms, and our doings were finally cut short by the breaking of the rains on July 23. So abandoning all hope of further ascents, the whole party descended to Joshimath, and on July 30 recrossed the Kuari pass.

Next day Bruce and Mumm left for Kashmir, taking the guides down with them, while I went off on a long-cherished scheme to visit the valleys to the west of Trisul, and that of the Sukeram glacier to the south-east. By this means I hoped to link up the knowledge I had gained in 1905 with that of last year, and thus to be in possession of a fairly comprehensive view of the orography of the Nanda Devi group.

Of the Peri-Sutol valleys I have nothing new to add, nor any fault to find with the maps. I found that the G.T.S. peak, 21,286 feet, was universally known to the local people as Nanda Ghunti. The two terminal nalas of Silla Samudhar and Ghingtoli have been very rarely visited by Europeans, and would well repay further study.

In the latter part of August I visited Sunderdunga. This is more correctly written Sonadhunga, which means the "Golden Rock;" it is celebrated for the gold which used to be obtained by washing the river gravel there, and also for the number and malignancy of the local demons, who are particularly averse to the human voice. As the result of five observations, I obtained 10,636 feet as the altitude of the shepherds' huts, which agrees very well with the barometrical value, 10,620 feet, of the G.T.S. The place is approached by a very bad jungle track up the valley of the Sunderdunga (or Sonadhunga) river, the distance from the hamlet of Jatholi, though only 6 miles, taking six hours to cover.

On August 24 I visited the Maiktoli glacier, which descends from between the peaks A₂₀, 22,360 feet (sometimes known as East Trisul), and A₂₈, 21,858 feet, to a height of about 12,500 feet, according to the G.T.S. In the black gorge which leads from Sona-dhunga to this glacier is a permanent snow-bed, the walls of the gorge being so narrow that the sun can never penetrate its recesses sufficiently to melt it. It is formed by avalanches of winter snow, and on careful examination reveals most of the usual glacier phenomena, such as crevasses, lateral moraines, and ice-tables, all of course on a minute scale. This snow-bed is indicated on the map. Its altitude is between 500 and 1000 feet above Sona-dhunga, which would make it about 11,000 to 11,500 feet above sea-level.

On August 25 I started up the Sukeram Nala, and camped for four nights at the shepherd's cave, known as Sukeram Udiar, 12,570 feet. At this spot a beautiful blue poppy (sp. *meconopsis*) was very abundant. I had the plane-table with me, but the rains were not yet over, and unsettled weather prevented me from doing as much as I had hoped.

However, on August 28 I reached the great southerly bend of the Sukeram glacier, and mounting to the summit of the left lateral moraine, which is of a very unusual type, I had a fairly good view of the upper part of the glacier from a height of 15,500 feet. In place of the ridge shown on the G.T.S., between the peaks A₂, 22,360 feet and 20,010 feet, forming a water-parting between the Kurumtoli and Sukeram glaciers, I saw that these two peaks were entirely separated by the Sukeram glacier, which rises from the south-western flanks of the G.T.S. peak A₂, 22,360 feet, and the southern slopes of A₃, 22,490 feet, and is constantly fed by avalanches from the former peak. The massif centring in the G.T.S. peak, 20,010 feet, which the Danpurias of the upper Pindar valley call Simmu Saga, is entirely cut off from the East Trisul ridge, forming a southern outlying group of its own. Chakuri Jhaba was given me as the name of the second peak, 18,517 feet. This group sends down three glaciers towards the Sukeram, two of which unite with the main ice-stream. I have already pointed out* that the glacier shown by the G.T.S. as joining the Kurumtoli glacier on its eastern side does not in fact do so. It represents the head of the Sukeram glacier itself, which lies on a great shelf tilted up towards the west. The snout descends to 13,200 feet, and shows signs of recent recession. On the lower part of the glacier I shot a *bharhal*. It was interesting to find that the local *shikari* did not recognize it, but called it a *thar* (*Hemitragus jemlaicus*), of which there are large numbers about here. He was very loth to accompany me at all, and had it not been for the presence of the two Gurkhas, would probably have run away from this demon-haunted glen. It appears certain that no European or native had previously visited the glacier itself, and I failed to find any sportsman who had ever heard of *bharhal* in this locality. It offers a very favourable field for the mountaineer who is not merely actuated by the desire to break records.

I hope that it is evident from what I have written that my criticisms on the work of the G.T.S. are made in no captious spirit. The triangulation of the main features of the country is well known to be extremely accurate, and considering all the circumstances under which the survey was made, the errors in the topographical details are surprisingly few in number, and of no importance from a political, strategical, or economical point of view.

NOTES.

In the foregoing paper the words "right" and "left" are used in their true orographical sense, unless it is directly stated otherwise in the context.

The map which accompanies this paper is based upon the fixed points

* *Geographical Journal*, vol. 29, p. 210.

of the G.T.S. of 1 inch to 1 mile. The topography of the Bishi and Bagini valleys is from a plane-table survey on the scale of 1 inch to 2 miles, carried out by Havildar Damar Sing Rana, 5th Gurkha Rifles, with a little help from myself. A few portions of this area, to which he did not penetrate, and the rest of the ground covered by us, are drawn from corrections to the G.T.S. made on the spot by myself, and from photographs taken on various occasions by Mr. A. L. Mumm and myself.

The altitudes have been taken with two hypsometers and two ($4\frac{1}{2}$ and 3 inch) Watkin mountain aneroids. I am immensely indebted to Dr. Gilbert T. Walker, F.R.S., Director-General of Observatories, Meteorological Department of India, who has most kindly had thirty-two hypsometer and ninety-seven Watkin aneroid observations worked out for me. Each observation has been worked out separately, although they only deal with some sixty places. The meteorological observatory at Muktesar, 7500 feet, close to Almora, has been taken as the lower station. From May to September the maximum variation of the daily mean was only 0.35 inch. The Smithsonian tables have been used throughout, in preference to Airy's tables, which would give higher values. I am, however, entirely responsible for the final results as given in this paper.

The great majority of our camps have been fixed by one, two, or three hypsometer readings, but to obviate any overestimation, 200 feet has been subtracted from each result. Mr. Reeves assures me that this is a more than sufficient allowance for the probable error. At the same places sometimes as many as seven observations were taken with the Watkin aneroids. Combining these results with about half a dozen G.T.S. values, I have a very good series of control observations for the Watkin aneroids, from which the rest of the altitudes, and the differences in altitude mentioned in the text, are obtained. Both aneroids invariably but consistently underestimated the height, doubtless due to the fact that owing to our great mean elevation during five months they had to be kept constantly closed (*i.e.* out of action), and that I never gave them more than half a minute to "settle." This error has been averaged and allowed for, but all odd feet have been cut off, so that the results are given throughout in round figures, as I do not believe that any barometric or hypsometric method of determination can be absolutely relied upon in a mountainous country. Most of the altitudes determined by me are given in brackets. In the case of the level to which the various glaciers are stated to descend, it must be remembered that, owing to the accumulation of moraine stuff at the snout, it is often impossible to tell exactly how far the ice itself actually extends. As a rule the G.T.S. mistakes heavily morained ice for *terra firma*.

I am indebted to Prof. E. J. Garwood for naming some geological specimens, for the loan of a plane-table, and for much valuable advice before I left England.

Before the paper, the CHAIRMAN (Mr. Freshfield, Vice-President) said: The paper to be read to-night is on explorations in the Himalaya. Since it is only two months ago that we had a very interesting paper from Dr. Workman on his explorations in the Himalaya, it may seem to you somewhat soon to return to the same region. But I may point out, I will not say excuses, but reasons why we should find ourselves paying more frequent attention to the mountainous portions of the globe. As exploration goes on, the level, or comparatively level, regions are naturally the soonest exhausted, and adventurers turn to the unexplored regions, either to the snows of the Poles or the snows of the Peaks. There is another reason which I might allege: that the Himalaya is a term which covers an exceedingly wide tract of country. I would not impute to any Fellow present any lack of intimate knowledge of the Himalaya, but I cannot but recollect that in this hall I was asked, when I went to Kangchenjunga a few years ago, whether I had been treading in the track of Sir Martin Conway. Now, the distance between Kangchenjunga and the scene of Sir Martin Conway's travels is equivalent to that between the Gross Glockner in Carinthia and Mont Perdu in the heart of the Pyrenees. Therefore, though we may be talking about the Himalaya, we are not talking about the same region. Dr. Longstaff's paper is a description of a district in the centre of the Himalaya, roughly speaking, north of Agra. If you look for it in your atlases, you will find it just to the west of that long green caterpillar that crawls along the back of India, the native state of Nepal.

With regard to the author of the paper, he does not require any introduction to this audience. He must be doubly welcome, first as the son of a father who, when His Majesty's late Government found themselves inadequate to support the great Antarctic Expedition, made it a possibility, and secondly, because we already know Dr. Longstaff here. He published a paper in the *Geographical Journal* of February, 1907, on his previous Himalayan journey in company with Mr. Sherring. The present expedition is, I should remind you, the result of the proposal, the unfortunately unsuccessful proposal, that was made to His Majesty's present Government, that an expedition should be sent, at no cost to the nation, but entirely at the cost of those who were undertaking it, to explore the neighbourhood of Mount Everest, and to ascertain the accessibility of the highest mountain in the world. When the present Cabinet refused leave to that expedition, the members of the Alpine Club who were prepared to undertake it diverted their thoughts to something of a more modest kind, and set out on the journey of which I will now call upon Dr. Longstaff to give you an account.

After the paper, Mr. FRESHFIELD said: I have listened with very great pleasure to the graphic description which Dr. Longstaff has given us of an Himalayan district, one of the most graphic descriptions we have ever had in this Society. I am sure we have all followed his adventures with the keenest interest, and that I am only interpreting the sentiments of every one here present in saying that we have thoroughly enjoyed his lecture and the most beautiful series of photographs which he has put before us to-night. My only regret is that since we are pre-eminently an Early Closing Association, Dr. Longstaff has been unable to give us the solid results of his journey, the mass of observations, geographical and topographical, which he and his companions have made. However, I remember what Sir Roderick Murchison said to me forty years ago, when I first read a paper before the Society. "Tell them your adventures, and print your results." And fortunately we shall have the advantage of reading in an early number of the *Journal* the full results of this remarkable expedition. Dr. Longstaff and his companions have done a very solid piece of work, and they have been fortunate in crowning it by an exploit, which may perhaps be more appreciated at the Alpine

Club than it is here, the conquest of Trisul. That mountain has two advantages: in the first place, it has been triangulated, and therefore there can be no dispute as to its height; and, in the second place, it is one of the historical, perhaps I should rather say one of the legendary, peaks of India, one of those great pinnacles of everlasting snow which look down upon the heated inhabitants of the plains, and are associated by them with the Abode of Deity. I am sure I shall also interpret the sense of this meeting, if I express our keen sympathy with Dr. Longstaff's companions, Major Bruce, who has done more, perhaps, than any man for Himalayan exploration by his training of the Gurkhas, and also with Mr. Mumm, for the unfortunate, though happily temporary accidents, which prevented them both from taking part in that crowning mercy, the ascent of Trisul.

Dr. Longstaff has, like all Himalayan travellers, had to suggest corrections in the topographical detail of Survey maps. I have said *Himalayan* travellers, but I might have dropped the adjective, for all mountaineers have to do the same thing. If Napoleon the Great was the founder of European cartography in the political sense, General Dufour was the founder of scientific mountain cartography. The Swiss Survey is the only one in which extensive alterations have not had to be made since the snows came to be explored by mountaineers. Twenty-five years ago, when mountaineers first went to India, they no doubt, some of them, expressed their criticisms crudely. They were misunderstood, and a certain amount of antagonism was excited between surveyors and climbers. All that has happily long passed away, and, if they sometimes criticize, there are no people in the world so well able to appreciate the merits of the Indian maps and the difficulties under which they were constructed as those who wander among the hitherto inaccessible recesses of the mountains. One of the first-fruits of the cordial understanding that now exists is the fact I mentioned here some months ago, that the Geological Survey of India are undertaking a series of measurements of the movements of glaciers, such as were first instituted by the Alpine Club in Europe. There is a further suggestion I should like to make—that the idea of starting in India an Himalayan Club, first suggested by the Kashmir surveyor, Mr. Johnson, should be followed up. Such a body might do a great deal, by collecting observations and by publishing a journal, to assist mountaineers; it might study the question of reaching the highest altitudes. I have several suggestions that I might make as to how any attempt should be made to reach 29,000 feet, but I see among the audience my friend Mr. Woolley, President of the Alpine Club, and I will leave that branch of the subject to him.

I notice that at the last meeting, when we discussed the Himalaya, Dr. Longstaff referred, as he has again to-night, to Mr. Graham's ascents. These ascents were made too early. Twenty-five years ago they were ridiculed in India, and they are still disbelieved by many people, whose opinion is worthy of consideration, in this country. This was to a great extent Mr. Graham's own fault. He described his travels without any of the precision in detail which is expected of the modern explorer. But as I was mainly responsible for bringing them before the attention of this Society, I must confess to having felt a certain satisfaction in finding that the two main grounds upon which they have been disputed have fallen through. One ground was that it was impossible to climb above 20,000 feet at the pace at which Mr. Graham said he climbed. Dr. Longstaff has climbed faster at the same altitude. The second was, that Kabru was an inaccessible mountain. Now, on October 20 last two Norwegians climbed to the summit ridge of Kabru. With regard to these two plucky Norwegians, I would add a few words. They reached the summit ridge of Kabru between the two peaks, but did not go to either top. They started too late, and they had much step-cutting, and

time prevented them. They climbed apparently to 23,800 or 23,900 feet. But do not fear that I am going to trouble you with any discussion about records. I was born before records were invented, and if an old mountaineer may give advice to his younger friends, I would strongly recommend them to follow Dr. Longstaff's example—not to insist too much on records, to think more of getting to the tops of their peaks, and less of getting higher than their rivals. For a record in mountaineering is, after all, a very fleeting possession, a very transitory joy. The spirit of the Alpine Club has never been, if I may say so, one of self-advertisement or of jealousy; it has rather been one which might be expressed in the words (slightly altered) of a living poet, the Poet Laureate of the English race, Mr. Rudyard Kipling—

"And no one shall *climb* for money, and no one shall *climb* for fame,
But each for the joy of the *climbing*."

And I would add, for the memory of it in after-years.

I will now ask Dr. Longstaff's companion, Mr. Mumm, to address us.

Mr. MUMM: There are two things I wish to say to persons about to go mountaineering in Garhwal: first, they should take the precaution of being somewhere between twenty-eight and thirty-five years of age, and, secondly, they should concentrate, and not try to cover too much ground. It was largely due to my neglect of the first of these points that I did so little climbing in the first part of my journey; it was disregard of the second which led to none of us doing very much in the second stage of it. Of course, in a new country which one is not likely to return to, it is very tempting to try to see as much of it as possible, and I am not sure that I did not get as much pleasure from our actual wanderings as I should have done if we had wandered less and climbed more. But you cannot have it both ways. In the Alps you can have it both ways. You can go over glacier passes or traverse the tops of peaks, and need never sleep two nights in the same hotel. But when you have got to carry your hotel about with you, it is a different matter. There is a magnificent field in Garhwal for mountain travel of both kinds. For the wanderer there are the great glaciers, all abounding in superb scenery, and many still wholly unknown and full of surprises. They are most of them very accessible; indeed, their moraines are almost the only places in Garhwal along which you get a decent place to walk. As for the climbing possibilities, they are simply limitless; but if you want to climb, you must, as I said, concentrate, and you must not yield too much to the spell of the great giants. I think Kamet was to our party rather a will o' the wisp. Our Italian guides, the Brocherels, were always pining to go to the top of something: they didn't trouble themselves as to whether it was 23,000 or 21,000 feet, nor as to whether it had a name or not. Their attitude was, "Here are the mountains: they are big, they are difficult, no one has been up them; what more can anybody want?" I think this attitude is the one most likely to lead to successful climbing in the Himalaya. I should myself like nothing better than to return to Garhwal in that frame of mind, and I have a beautiful programme for my next visit. I should not go near Kamet or Nanda Devi; there would be lots of climbing, and I should only shift my camp twice, one day's march each time. I should finish up at the glacier above Gamsali, which I have a special reason for wishing to revisit. I did go up it for a considerable distance, and I had a very curious experience. It was very much as if one had started from the Furca Hotel to explore the Rhone glacier, relying on a map which showed that the upper part of the glacier was surrounded by a circle of rocky mountains, and one found instead that the glacier went down the other side and disappeared round the corner on the way to the Gadmenthal. That, of course,

is what you do find when you go up the Rhone glacier; I am not prepared to guarantee that the same thing happens with the glacier above Gamsali, but that is what it looked like. I had to shelter from a snowstorm for a long time, and when I got to the point from which this unexpected behaviour of the glacier was visible, it was too late to go any further, and so that little topographical problem had to be left unsolved. I have referred to it, partly because it is a good illustration of what I was saying about the interest attaching to glacier exploration in these regions, partly also because it is the one interesting thing that I found out all by myself. The clearing up of that problem will be the last of the agenda on my programme next time I go to Garhwal. Only I am afraid there never will be a next time.

Mr. H. WOOLLEY: I regret not to be able to make any important comment on the very interesting description to which we have listened, as I have never ascended to a greater height than 18,500 feet, and have never suffered directly from the effects of diminished atmospheric pressure, whereas I believe that the serious effects of an insufficient supply of oxygen begin, with a man in good training, at about 20,000 feet. The problem with regard to the height attainable by a pedestrian has reached a very interesting stage. Taking the highest point gained hitherto at 24,000 feet, Dr. Workman, who gave us an address here some weeks ago, seems to think that, owing to the great loss of strength and vitality due to the difficulty of respiration, the limit will be reached, even on an easy gradient, within the next 3000 or 4000 feet. Dr. Longstaff is more hopeful, and his party did not seem to be affected to anything like the same degree as Dr. Workman's party. But Dr. Longstaff will probably admit that in order to reach the higher summits—say of 26,000 feet and upwards—it will be necessary to have two parties. The first party, as lightly equipped as practicable, will complete the final ascent; the second party, also composed of experts, will accompany the first party as far as possible, and up to that point keep them supplied with necessaries, and relieve them of all labour except the actual labour of locomotion. It will be interesting if an experiment on these lines can be tried on a mountain presenting no very great climbing difficulties. Dr. Longstaff's photographs were very beautiful and instructive, and some of the most striking views were those of the gorges showing what a wonderfully effective cutting instrument a mountain torrent is. I have listened to the description this evening with the greatest interest and pleasure, and am very glad to have this opportunity of congratulating Dr. Longstaff on his notable ascent of Trisul.

Sir THOMAS HOLDICH: I have nothing but admiration to express for the energy and the ability which Dr. Longstaff has shown in conducting this very remarkable expedition, and nothing but admiration for those splendid photographs, which incidentally prove most conclusively that he certainly did ascend to the extreme summit of Trisul. But there is just one point which I should like to make to-night, and it is a point which was suggested to me. As I was leaving the office of the R.G.S. this afternoon, and passing through the Burlington Arcade, in that classic spot I met an ex-Surveyor-General who suggested to me that, as it is impossible, and has always been impossible, for the Survey Department of India to undertake the topographical survey of such remote regions as have been visited by Dr. Longstaff, it might be well if we could press some of these Himalayan climbers into our service in order to obtain certain scientific observations which would be of the utmost value in future. I need not remind you that barometrical observations for altitude are really of very little value. I do not say that they are of no value, because certainly in the absence of any other method of determining altitudes, they are better than nothing; but an observation taken trigonometrically,

that is to say, by an observed altitude from a known height, is a far more conclusive observation for finding the altitude of a distant peak than any barometric determination. Triul is one of those peaks of the Himalayas which has been exceedingly well fixed. We know precisely its position, and its altitude almost exactly; I say almost because there are certain corrections, certain weaknesses about those observations, which require eliminating, and the greatest weakness is the fact that we never know exactly what tricks refraction may be playing in high altitudes. Now, if an observation is taken from a low station to a high peak, and its altitude is fixed in that way, the error which may be introduced by refraction is considerable. If, on the other hand, the observation can be taken back from that high peak to the point from where the observation was taken, that source of error is entirely eliminated. Not only is it eliminated, but a value for the error induced by refraction is obtained, which will serve a most useful purpose in determining the altitude of other peaks. Now year by year we are demanding from explorers and from mountaineers more and more close observation, more scientific application to their work than has been hitherto accorded to it. I think you will all agree that in late years we have succeeded in getting more. To me it is marvellous how men who succeed in attaining these great altitudes can ever summon up the amount of resolution that is necessary in order to take the persistent and constant observations which are necessary for scientific purposes; but in this case we must ask them to take one more. If they will only observe from those high peaks what the angle of depression is to some point from which that angle of elevation has been taken, they will be doing an immense service to scientific surveying. I think in asking this we are really not asking very much, for it is not necessary to convey any very heavy instruments to the tops of peaks for this purpose, so that I hope in future that amongst Himalayan climbers we may find some who will work hand-in-hand with the professional surveyors in India, and give us real assistance by their observations. Dr. Longstaff has referred to the ascent of Kabru by Mr. Graham. Now, there was never any doubt whatsoever in the minds of any professional surveyors that Mr. Graham did make a very notable ascent, and did succeed in attaining an altitude which had probably never been reached before. The doubt was whether he had ever actually succeeded in reaching that particular peak which he claimed to have reached, and the points on which the doubt arose were not exactly those described by the Chairman. I was here when Mr. Graham's lecture was read, and my conviction was that he had not quite succeeded in identifying his own position. It is quite clear from what we have heard to-night that, whatever point he reached, he did not succeed in identifying Mount Everest, and as he said that he found elsewhere, on looking round him, that the trigonometrical survey of India was all wrong, and that there were mountains where there ought to be valleys, and valleys where there ought to be mountain ranges, there still remains to my mind some explanation necessary for this very extraordinary phenomenon. Is it possible that, whilst he failed to recognize the peaks around him from Kabru, he was actually on the point he supposed himself to occupy? I do not know whether after all these years that doubt will ever be quite satisfactorily cleared up, but it would have been in those days an immense advantage to him had he possessed what Dr. Longstaff possesses—photographic apparatus, and a photographer capable of illustrating the fact that he was on the top of the peak. I have nothing more to say, except to join with others in congratulating Dr. Longstaff on what is certainly a very remarkable and will be a very memorable ascent.

MR. FRESHFIELD: I propose to call on Sir Martin Conway, but I would first make one remark in reply to Sir T. Holdich's criticism with regard to what I just said about trigonometrical altitudes. In describing them as indisputable, I meant

relatively final. I must point out that twenty years ago, after consultation with Mr. Whympster, I criticized the determination of 29002 feet given for the highest mountain in the world, and suggested that until it had been measured from some points where the effects of refraction were likely to be less serious than in the plains of India, its height could not be considered as absolutely fixed.

Now, I want to ask Sir Martin Conway to tell us something about the so-called *nieve penitente*. You may recollect that two months ago Dr. Workman described having seen in the Himalaya a series of snow-pinnacles similar to those which have been very minutely described by Sir Martin Conway in the Andes. I do not know if Sir Martin is aware of it, but they were seen before him by another South American traveller, who not only found a collection of those extraordinary snow-pillars, but one of them which served as a pedestal for the frozen carcass of a dead horse, what I may call a *cheval perché*. No doubt the unfortunate animal had perished in the snow in the winter. The traveller in question was Dr. Darwin. I hope Sir Martin Conway will be able to tell us whether the phenomena described by Dr. Workman seem to him similar to those which he saw in the Andes, and also whether he accepts Dr. Workman's description of their causes: first wind, and then sunshine. I would suggest that, if these snow-pillars exist in other regions than the Andes, we should find some English and less far-fetched term to describe them. That of *nieve penitente* was derived from a fanciful resemblance to a procession of white-robed penitents.*

Sir MARTIN CONWAY: At this late hour, I am afraid it would be impossible to go very deeply into this question of *nieve penitente*, and I think I should hardly be justified in referring to it at all, if it were not that in one of the photographs, taken, I believe, on Dr. Longstaff's former expedition, there seemed to me to be some appearance of rudimentary *nieves* in the foreground. I saw no examples in the Karakoram, and I have heard of none observed in the Himalayas except by Dr. Workman in the Nun Kun range. It is almost only, so far as I know, in South America, and within certain definite limits of latitude, that they occur. They are certainly a phenomenon confined within regions of low latitude, and they have nothing whatever to do with the wind. If they were caused by winds, they would have been found in polar regions. They are caused undoubtedly by the melting effect of a relatively vertical sun. It is impossible to describe very briefly and without illustration the manner of their origin, but it has been completely and satisfactorily accounted for. One peculiarity that they have is that the major axis of their horizontal section lies always approximately east and west, unless there should be mountains that shade them from the morning or evening sun, when their axes may be somewhat twisted towards south-east or south-west. It was observing this twist and the cause for it that first opened my eyes to the true origin of *nieve penitente*; the explanation I gave has since been generally accepted.

Prof. GARWOOD: In spite of the early-closing rule mentioned by the President, I cannot refrain from adding my congratulations to those which have already been offered to Dr. Longstaff and his companions. There are many points of great interest in the paper. I will to-night allude to only one of these, namely, the character of the valleys below the snow-line, shown on the screen. I think that every one must agree that they are essentially water-cut gorges, and that ice had little or nothing to do with their formation. Again, that stream which appeared to cross a watershed seems to point unmistakably to a phenomenon that we noticed also in the

* For observations of this phenomenon in the Andes and on Kilimanjaro and a discussion of its origin, see *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1908, No. 2, and also p. 449 of the present number.

Sikkim Himalayas, namely, the evidence of an elevation of the whole mountain group at a recent date. The rivers here also appear to have received additional erosive power so as to enable them to cut those wonderful gorges, some of which, I think the author said, were 1700 feet deep. The fact that they have not been widened by atmospheric agents points conclusively to their very recent origin. The retreat of the glaciers shown also in this district is another point of great interest. The presence of "hanging" valleys occurring in the main valleys themselves is a most suggestive phenomenon, and one to which I recently called attention in the Alps. It is very instructive to find the same thing here, proving again that glaciers must, till recently, have protected their beds from the downward erosion by water such as took place in the valley below the termination of the glacier. At this late hour I will only once more add my congratulations on this very admirable expedition.

Mr. FRESHFIELD: We have had a very interesting paper, followed by an interesting and important discussion, in which various points of scientific interest have been raised. I have already informally expressed the thanks of the Society to the reader of the paper, Dr. Longstaff.

Dr. LONGSTAFF: I am afraid I have not made it clear that I was not the leader of the expedition. We all three worked together to the best of our abilities, but if any one of us deserves the title it is Bruce. I will only mention one other matter: Graham's reference to the irreconcilability of his maps with the actual configuration of the country applies to the Rishi valley and not to anything that he saw from Kabru. I would add that our largest cameras were quarter-plate size, as every ounce has to be considered when coolies are not available.

FURTHER EXPLORATION IN THE TIAN-SHAN MOUNTAINS.*

By Dr. GOTTFRIED MERZBACHER.

THE rigour of winter has for some time interrupted my scientific pursuits and forced me to take up quarters here. I make use of the opportunity to communicate some particulars respecting the course of my expedition down to date.

My departure from Munich was made on April 17, 1907, in company with H.R.H. Prince Arnulf of Bavaria, who, chiefly for the sake of the big game abounding in their valleys, had determined to travel in the Tian-Shan. The impulse to the journey came chiefly from the Prince. The invitation to join him with which he honoured me was, however, all the more grateful to me inasmuch as I had for some quite considerable time been cherishing the wish to follow up my researches in the Tian-Shan, and as in a most generous manner His Royal Highness rendered the prosecution of my scientific pursuits practicable. Unhappily His Royal Highness, after a happy hunting expedition pursued without adverse incident of any consequence, and after his return in complete health to Europe, succumbed at Venice, on October 18 last year, to inflammation of the lungs. The early and unexpected death

* Dated "Kulja, February 9, 1908."

of my noble patron casts a dark shadow on an expedition which was entered on with such joyful expectations.

His Royal Highness and I passed into the heart of Asia by way of the Caucasus, Transcaspia, and Turkestan. In Tashkent we foregathered with the other partners of the expedition: Dr. Kurt Leichs as geologist; Francis Kostner, from Corvara in Tyrol, as guide, who had already accompanied me on a two years' journey through Tian-Shan; P. Rockinger as taxidermist; Francis Borgar, from Eisenerz in Styria, His Royal Highness's hunter. From Tashkent we travelled together through Semirechensk to Issik Kul lake, and thence to Kulja, where the expedition was organized and whence it took its departure.

The reasons inducing me to make a third journey into the Tian-Shan mountains rest on the consideration that, however rich the booty of observation heretofore gathered by me, it yet, on closer examination, seemed to me to supply but inadequate basis for my investigations into the history of the more recent development of the mountains. On the contrary, urgent necessity rather impelled me to draw within the compass of my observations the eastern parts of the central Tian-Shan, including the chains stretching farther to the east. The past year was devoted to the first part of this my programme. The expedition chiefly occupied itself with the exploration of the river-systems of the two greatest mountain rivers draining the northern slope of the central Tian-Shan,—Kok-Su and Agias. The valleys of these two mountain rivers, both of which, after flowing a very considerable length in longitudinal valleys, suddenly bend round and pass into transverse valleys, delivering their waters into the Tekes, had hitherto fallen more within the scope of sporting circles than within that of scientific explorers. English and more particularly Anglo-Indian hunters, allured by the abundance of game in these valleys, especially by the extraordinary size of the ibex and wild sheep of these regions, had repeatedly picked them out for the arena of their sport.

By my expedition, the hydrographic system of the two rivers and their most important tributaries were now investigated as far as their highest sources, including the glaciers, hitherto totally unknown, lying in the valleys at their sources. In this investigation special attention was paid to the structure and the composition of the mountains, as also to the causes of the peculiar valley formation. Not wishing to forestall the comprehensive report which is left in abeyance till after the close of the expedition, I should like here, in respect of the two river regions, only to state in brief that in extent they fall short of the glaciers of the great longitudinal valleys, Sary-Dokhas, Inylohek, etc. The biggest of them do not reach beyond $7\frac{1}{2}$ to $12\frac{1}{2}$ miles long. Their number and diffusion, on the other hand, are very great. In particular parts, too, of the region, glaciation is notable. The total extent of territory covered by firn and ice is far larger than I had expected. This covering lies

particularly thick in the upper regions of the headwaters of the Agias, as also in the region of the chains parting the Agias from the winding course of the middle Kok-Su. Some of the glaciers investigated are distinguished by uncommonly complicated structure. Such, *e.g.*, are those of the great valley of the Kopr-Sai, tributary to the Agias, and those of the Khaptu-Su valley belonging to the same river-system.

With respect to the geological structure of the territory examined, I confine myself to the statement that, as might be expected from the already published geological and palæontological results of my former expedition, no fundamental deviations indeed as to structure and geological composition come to light in that part of the Tian-Shan recently brought within the sphere of investigation, as compared with the regions before traversed. Yet withal there do spring into notice substantial differences concerning both the structure of the mountains and the distribution of the different kinds of rock. In this part also of the Tian-Shan the kernel of the mountain chain is a purely sedimentary one, and the highest watershed between north and south is formed by metamorphosed, presumably Lower Carboniferous limestones (marble, dolomite). In the system of the watershed, besides, a striking parallelism of structure becomes more and more evident. There is here, on the other hand, a far thicker distribution of certain eruptive rocks, more particularly of quartz, porphyries, and related rocks, and in part also of the younger porphyries, than in the western central parts of the mountains. Leaving out of account the great part which, in the formation of the thick series of crystalline slates, must be attributed to dynamo-metamorphic processes, the influence of contact-metamorphism exerted by the eruptive rocks on the surrounding masses of rock is, accordingly, beyond comparison more important. The participation, however, of the granite in the structure of the mountains, especially in the interior chains, here falls substantially short of that obtaining in the dominant conditions of the western part. The generally steep uplift of the layers and the predominance of the north-easterly trend constitute here, too, remarkable characteristics of the structure.

An unexpected distribution and uncommon thickness are attained by the recent formations (red conglomerates, clays, marls, and sandstones), characteristic of the Central Asiatic mountains, in the upper Kok-su territory, where they form independent chains rising to over 13,000 feet. Till, however, I have extended still farther east my observations of these sediments, I refrain from hazarding a conclusive judgment respecting the mode of formation. All the same, I should like even here to point out that it seems to me a mistake for any one to generalize too dogmatically in this matter. The more occupied I am in the examination of these formations, the more is borne in on me the conviction that they are not to be explained from a common origin.

On the contrary, the more do I become persuaded in reference to the mode of formation of these deposits, and in the face itself of their very varied character, that the deposits piled up in the interior basins of the mountains must be distinguished from those deposited in the great river-valleys, and these, again, from the recent formations deposited along the edge of the mountain system. Through extension of my observations to the eastern chains, I hope to be in a position to throw more light on this difficult problem.

Of unusual extent and in good preservation are the traces of the diluvial Ice age in many parts, visited by me, of the mountain system. Convincing evidence has also come to hand in favour of the opinion formerly pronounced by me ("An Expedition into the Tian-Shan Mountains"), that, in respect also of these mountains, several larger phases of revolution, with intervals of periods of retrogression, must be assumed. In Mus-tamas valley, *e.g.*, there lies over well-preserved old moraines diluvial grompholite; above this again thick moraine, which in its turn is next covered by more recent grompholite; and above these again are piled masses of moraine of the most recent Ice age. In the Saksan-Teke (tributary to the Kok-su) valley consolidated old moraine was found, ground smooth by advancing ice of a later period. In the Agias valley is seen a beautiful example of the sliding of younger moraine over older, whereby sand-clay deposit, intercepted between them, got dislodged in an extraordinary manner. Similar demonstrations offer themselves in plenty. Altogether, it would not be easy to find a spot where, in a manner more convincing than here, the explorer is, step by step, reminded how in great part the present configuration of the mountain system is due to powerful climatic oscillations, and how periods of great moisture and great drought have repeatedly alternated one with the other. Only under such conditions are to be satisfactorily explained the peculiarities of the valley formation of this region—its diversity, its manifold ramifications. To these conditions my observation was specially directed.

On the conclusion of my labours in the two great river-systems mentioned, I turned anew to the great Musart valley with a view to filling up certain gaps in my knowledge of this region. The more important lateral valleys, whose acquaintance I had missed making on a former occasion, were now looked up. The glacier system, again, of the uppermost basin of the valley enclosing wonderful ice-currents of exceedingly rich articulation, could this time be more minutely examined and sketched. In this way I shall also be enabled to adjust statements made respecting the course of certain glacier valleys radiating from the central massif, embodied in my former report of travels ("An Expedition into the Tian-Shan Mountains") and in the map accompanying it.

In the course and towards the conclusion of the year's expedition,

the opportunity has presented itself several times of turning greater attention than heretofore to the structure of the secondary chains extending from the river Tekes.

Unfortunately, the labours of the expedition were encroached upon and retarded to an uncommon degree by the weather of the past summer and autumn, wet and unfavourable beyond all precedent. Out of four summers passed in Tian-Shan this last was the most unfavourable. It will give a fair idea of the kind of weather dealt out to us if I remark that in the course of six months we had but nine days completely free from precipitation. Under almost exclusively west winds there came almost every day rain or snowfall. The whole period of glacier-melting is to be reckoned at hardly six weeks. Even at the beginning of July most of the glacier currents were readily crossable, and by the middle of August the water from the melted ice no longer offered any obstruction. Frequently in the middle of summer we were transported into truly winter landscape. By the middle of September winter set up in the mountains his stern rule, no longer subject to any relaxation, a rule which extended far down into the foothills.

It will be understood how, under such conditions, there can be no talk of a retreat of the glaciers. Almost everywhere the glaciers betokened stability; in some cases an inclination to advance. It needs but a few more of such years to induce a general advance of the glaciers of the mountain system. Exceptions from these conditions could be observed only in the territories at the upper waters of the Kurtai and the Jirgalan, where the glaciers were in decisively vigorous retreat. Further particulars on this subject I reserve for the later comprehensive report.

The abnormal weather did not rest confined to the high mountains. All over Semirechensk unusually heavy and continuous precipitations were experienced, with markedly lowered temperature. In high situations, as in Varynkol (Okhatnishi) and other places, the corn could not be led in. In many parts of Turkestan, too, an increase of precipitation has for a number of years been observed, especially in the past year. The following data I owe to the kindness of the director of the Tashkent Astronomico-Physical Observatory, Colonel Ossipoff:—

				Mean annual precipitation during the ten years ending Dec. 31, 1906		In 1907	
Sarmarkand	...	...	...	18.193 inches	...	19.528 inches	
Margelan	...	...	...	6.870 "	...	8.307 "	
Aulicata	...	...	...	10.992 "	...	13.152 "	
Kerki	...	...	...	5.349 "	...	9.912 "	

The figures in the two last entries of the above table cover only eleven months, to the exclusion of December.

As appears from the notable investigations of L. S. Berg, the surface of the Aral, as also of Lake Balkhash, is steadily rising. Further data have since been obtained demonstrating the continuation of this ascending

movement, which involves also the Ala-Kul lake. It may, perhaps, be assumed that for Central Asia there has set in the beginning of a period of great precipitation, of a climatic oscillation, on the duration and importance of which nothing definite can of course yet be said. Here in Kulja, where I am compelled to put up for some time till it is again possible to travel, the course of the winter is abnormal. It began about the middle of October, a full month, namely, before its usual time, and it continues ever since with uninterrupted rigour and with extraordinarily abundant snowfall. The staff of the Belgian Mission Station, which has now been planted here for sixteen years, have no memory of any winter at all approaching this one in magnitude of snowfall. The snowy mantle has now a thickness of 5 feet, and since New Year the temperature oscillates between -4° and -18° Fahr., with extraordinarily violent and frequent barometric oscillations. My meteorological lists ought this time to contain quite peculiarly interesting data.

Dr. Leuchs having, in the beginning of December, begun his return journey, I hope, in the beginning of March, on the arrival of my new geological coadjutor, Dr. P. Groeber, to start once more for the mountains.

ON THE OBSERVATION OF DESERT SAND-DUNES.

By VAUGHAN CORNISH, D.Sc.

THE following suggestions for observations of desert sand-dunes have been formulated in reply to the letter of an intending traveller in North Africa. I have at various times been called upon for such notes by travellers proceeding to Australian, Indian, and other deserts, and it occurred to me, therefore, that such suggestions might be of use to other Fellows of the Society.

1. I think the most pressing thing in dune-study is the measurement transversely of a series of ridges of sufficient size to be called sandhills, i.e. such that the lower layers are compacted by weight, and possibly by moisture, although devoid of foreign binding material, such as, e.g., redeposited carbonate of lime. The point is to ascertain if a series comprising many ridges will give an average ratio—

$$\frac{\text{Length from crest to crest}}{\text{Height from trough to crest}} = 18 \text{ (approximately).}$$

In the *Geographical Journal*, January, 1900, it will be seen that I found this to hold for *les dunes elementaires* (as, I think, French observers call them) when averaged up, this being the same ratio as for each of the well-known æolian ripples of loose surface sand.

If several such cross-sections can be obtained in different localities,

the results cannot fail to be valuable whether the figures be confirmatory or otherwise, provided there be a sufficient number of consecutive ridges included in each group. The amount of time at one's disposal being always a controlling factor in the work of a traveller, I would lay down the following rule for these measurements, viz. include as many ridges as possible, and measure with less minuteness rather than use up time in refined measurements of a short series of waves

A good check on this measurement of a long series is to take the cross-measurement of two consecutive waves (three ridges) of the same group at a number of different places and average them up.

Second only in interest to the above are the following points, viz. :—

2. Longitudinal extension.—In Sindh there are longitudinal dunes formed, I doubt not, by wind action on partly consolidated sand containing some carbonate of lime derived from *foraminiferae*. In addition to the processes for forming longitudinal structures described in my paper on Snow Drifts (*Geographical Journal*, August, 1902), there has also, I think, in Sindh, been a process of building up a long continuous ridge by filling between, and thus joining up the comparatively short residual longitudinal ridges left by the cutting through of the semi-consolidated transverse ridges. It would be a good plan to look out for such structures, and a repetition of such processes in other deserts, particularly where there is some material to make the sand more compact, particularly in the lower layers.

There is also to be observed, and more particularly described and photographed, the longitudinal arrangement of consecutive crescentic dunes (*medaños*). Also, I understand that west of the Nile there is a tendency for the dune *massif* to elongate itself indefinitely in the direction of the wind. This is what one ought to expect, the eddy produced by an obstruction being always much longer than the width or height, and the transverse arrangement being only the wave-structure, which is necessarily of comparatively small dimensions; of the elongated sandy shoals accumulated in sheltered positions in rivers, and their transverse ridging by current-waves and current-ripples (such as are described in my paper in the *Geographical Journal*, August, 1901). Nevertheless, more particular observation of these elongated dune *massifs*, and of the process by which elongation is accomplished, are certainly desirable.

3. The third point to which I would draw attention is the relation of dunes to atmospheric and ground moisture. Water is often easily obtainable at the foot of a large dune. Near the Nile delta this, as I found, was often the cause of the dune, sand-drift being slackened where the sand was wetted. Elsewhere, in the French Sahara, I have read that the moisture is an effect, not a cause, of the dune. The sand-hill undoubtedly absorbs rain, and, I think, holds the moisture in its

lower layers. The dew effects observed upon the dunes are very remarkable, even when there has been no rain for weeks, and but for the rapid evaporation in the day, one is tempted to think that dew-ponds might be formed, as on the porous chalk downs in England. Such moisture consolidates the lower part of the dune, but, readily evaporating at the surface, allows the top layers to be redistributed by the daily breeze. If strong and continuous winds remove the dry and loose surface too rapidly, erosion forms are produced in the compacted underpart. Thus from several points of view the relation of blown sand to moisture is worth studying.

4. I desire to draw attention to the exaggerated effect of certain storms in transporting sand, and even apparently of holding the finer particles in suspension. This may probably be due to an electrified atmosphere. I have found by experiment that sand, though heavy, is readily and violently moved by electrification, on account, I suppose, of the smallness of the particles. I have not myself gone much further into the interesting but difficult question of the effect of electricity upon the transport of sand. It may be that such winds are responsible in some deserts for much of the transport of sand, whilst the ordinary breezes do most of the modelling of the sand-dunes.

5. The rate of movement of dunes is, of course, interesting, but unfortunately a traveller can seldom deal with it.

Finally, whatever is to be described should be photographed, and the photographs should, whenever possible, be taken in a low morning light—a low light for shadow and relief; the morning, in order to avoid the sandy haze of the later day.

THROUGH EASTERN TIBET AND KAM.

By Captain P. K. KOZLOFF.*

INTRODUCTION.

ON Captain P. K. Kozloff's return to Russia in 1901, after his prolonged absence in Tibet, he put the finishing touch to his exploration work by compiling a most valuable scientific report on the lands through which he had passed. The following pages are a translation of that part of his narrative which deals with the expedition's adventures from the time of its leaving the Tsaidam on the journey south till it reached Chjerku.

During March, 1900, it made its way westwards along the northern bank of the lake Koko-nor, and, crossing the eastern Tsaidam, reached on April 14 the fortified post of the Baron-Dsassak (longitude and latitude $36^{\circ} 10' 55''$ and $97^{\circ} 21' 47''$; height, 9380 feet above sea-level). Here a dépôt was formed to serve the purpose

* Translated by Captain A. B. Lindsay, 2nd King Edward's Own Gurkha Rifles. In the *Geographical Journal*, vol. 19, p. 576, is a summary account of this Russian Expedition, 1899-1901, also by Captain Kozloff.

of a base while in Tibet, and here camel transport was abandoned. The journey onwards is related by Captain Kozloff as follows.*

Narrative.

With the expedition's arrival at Tsaidam the curtain may be said to have come down on the first act. For a whole year we had lived amongst Mongols—for the most part peaceful and good natured—learning about their country, studying their mode of life, and for transport using camels, an animal which Russians soon became accustomed to on the line of march, especially if commanded by experienced officers. We were compelled to part company with these animals here, and in their stead to possess ourselves of bull yaks, or khainiks.† These beasts live in the mountains and high tablelands of Tibet, where exist nationalities as different in their manners and customs to the primitive Mongols as their fierce and obstinate yaks are to camels.

Savage by nature, the bull yak, when on the line of march, in camp, or when grazing, is always trying to find an opportunity of goring his neighbour, regardless of whether the latter be a bull like himself, a horse, or a human being. The worst characters among them are easily recognizable by the broken points of their horns. Across mountainous country they are slow travellers (from 3 to 3½ versts an hour, sometimes less), while they carry only half the load of an average-sized camel. As, in addition to this, yaks are more subject to epidemic diseases than camels (plague, khas,‡ etc.), they often prove to be a more expensive mode of transport. The difficulties of travelling with them are infinitely greater than when using the far-famed—and deservedly so—"ship of the desert."

As a transport animal, the bull khainik stands considerably higher. It is more gentle and tractable, more used to narrow footpaths, and to a certain extent is dignified. Consequently it preserves its strength throughout the day's march instead of wasting it when leaving camp, as a yak usually does, by uselessly plunging about from one side of the road to the other. The khainik is, of course, much more valuable, costing about thirty roubles, while a transport yak can generally be bought for ten; that is to say, it is three times as expensive as the yak. A camel caravan can be loaded up more expeditiously than a bull caravan, as the men of the escort, divided into pairs, can work independently, and soon get the caravan ready. This is impossible with bulls. Each animal has to be held by one or two men, while its load has to be lifted up high at the same time § by at least four, two on either side. The loading of obstinate animals takes quite five minutes, and requires double the usual number of men, while the baggage suffers in proportion.

Having left the bulky and heavier loads at our Tsaidam depot, we packed our Tibetan baggage, reduced to the smallest limits, in small boxes, bags, and wallets. The ideal load for a yak is a pair of ammunition boxes weighing, including the felt lining, 5 poods. But even after reducing our allowance to the utmost, we found ourselves with thirty-five loads, to carry which we took forty bulls, the majority of them being khainiks. Besides myself and my immediate assistants, the *personnel*

* 1 pood = 40 lbs., 1 verst = $\frac{1}{3}$ mile approximately; 1 sajen = 7 feet; 1 rouble = 2s. 1d. approximately.

† Khainik, a cross between a bull yak and a domestic cow.

‡ With khas, yaks lose their appetites, saliva pours out of their mouths, and eventually their hoofs drop off.

§ Camels are loaded up differently. On the word "Tsok tsok" and a gentle pulling of the leading rope, they lie down, and the load need not be lifted high off the ground.

of the expedition consisted of twelve grenadiers and cossacks, to assist whom in managing the bull transport, to which they were unaccustomed, four local Mongols were engaged at the Tsaidam—two, Dadai and Chakdoor, from the village of the Dsun-dsassak, and the other two, Hardy and Jeroy, from the village of the Baron-dsassak. The first of our native companions, Dadai, had previously accompanied Prjevalsky as a guide and Tibetan interpreter, when returning from Lhasa to the Tsaidam on his third journey in Central Asia. In addition to these four Mongols, we commandeered a Chinaman called Li, who knew Tibetan. He was a fine-looking, powerful man, and, when not smoking opium, appeared well able to climb the mountains of Tibet. The Tibetan party was thus brought up to a strength of twenty men.

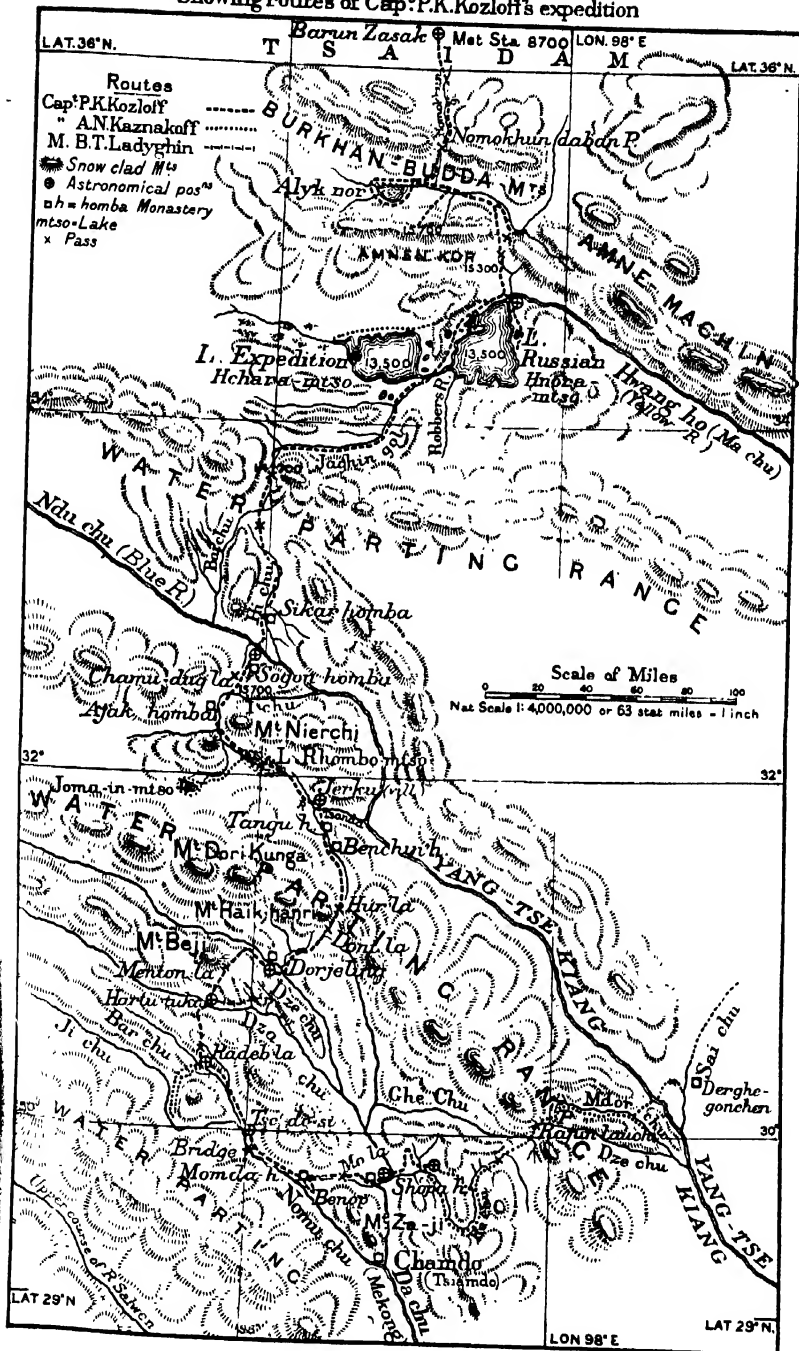
Besides the above, I also took Ivanoff (who was in charge of our depôt at the Tsaidam) as far as the lakes of the upper Hwang Ho and two selected Mongols to escort him on the return journey. I did this, feeling certain that, in addition to the boat, he would have to take back a large quantity of skins of mammals and whatever else we might collect, and I therefore took, besides the bulls, three transport camels and three ponies—one for each of them.

Meanwhile the rays of the spring sun were daily becoming more powerful. The shrub and grassy vegetation, coming to life again, beautified the bleak vale of the Tsaidam. In the air, which was fragrant with the aroma of fresh vegetation, the buzzing of insects and the twittering of swallows, soaring high above the mud-walled fort, never ceased for days together. We were all irresistibly attracted to the south, towards the mountains whose dark blue gorges were becoming more clearly visible. In one of those nullahs our Tsaidam hermits—Teleshoff and Afutin, who were in charge of the camels—had for some time past taken up their quarters. In addition to the Mongol shepherd engaged for the period of the depôt's stay at the Tsaidam, their paucity in numbers was supplemented by the dogs, which had been our faithful companions from the day of our start from Altaisk. To take the latter's place in the Tibetan caravan, I bought from a neighbouring Mongol a huge Tibetan mastiff called Garza.

By the middle of May we had completed our arrangements for the onward journey, and the 17th of that pleasant spring month was chosen for our start upon the long and little-known route. By daybreak we were all astir. Loads, bulls, and men filled the courtyard of the fortress, while Russian, Mongolian, and Chinese shouts intermingled to break the morning silence. In addition to those who were setting out, a large crowd of extraneous people had assembled, some of whom worked hard and were useful to us, while others chattered lazily and were a hindrance. The loading up of the bulls was commenced; but how different to dealing with camels! Several of the obstinate brutes lay down; others plunged about, and, having broken away from their attendants, never rested till they had thrown their loads. We spent a long time loading up in that narrow, confined space, and it was not till noon—the very hottest hour of the day—that we were at last able to leave the settlement and wend our way into the open valley. Then we were able to breathe more freely and look around us. After two or three hours' going, the caravan, divided into three sections, was maintaining proper order and moving steadily southwards. Looking back, we all took leave of the village, which seemed to us now so near and dear, and above which could be so clearly seen the meteorological station, as well as the Russian ensign fluttering in the breeze. Muravieff, who was doomed to many days of solitude, was standing on one of the flat roofs watching the fast disappearing column.

Beyond the rugged, flinty waste which rises gradually towards the hills, the Burkhan-Buddha range towers upwards, and in one of its nullahs—Nomokhun by

Showing routes of Cap^t P.K. Kozloff's expedition



name—we had arranged to camp. Close to us a small stream wound its way, gathering strength on its onward journey from the bubbling, murmuring brooks which tumbled into it, and instead of dust and saline deposit, we trod underfoot soft patches of green grass, and began to hear the monotonous cry of the jackdaw, partridge (*Caccabis chukar*), wild pigeon, and other feathered creatures.

The name Burkhan-Buddha, adopted from the time of Prjevalsky's first journey, is the name given to the comparatively small (in extent) range* bounding the southern end of the eastern Tsaidam. From this shut-in Central Asian basin, these mountains have the appearance of a solid uniform-shaped wall, supporting at a height of 17,000 feet a fairly flat summit (only in places does it reach the line of eternal snows), where the streams rise which tumble down on either side.

The foot of the hills on the northern side is 10,500 feet above the sea, but on the southern side it is nearly 13,500 feet, though measuring scarcely 12 versts from the top. On both sides the nullahs are stony, wild looking, in places very narrow and dark, and, thanks to the scarcity of water, bare and bleak. A few tiny rivulets, on issuing from the hills, bury themselves beneath the surface of the ground, appearing again at the bottom of the nullahs as springs or wells after their subterranean journey. These hills are composed of clear granite, with an admixture of plagioclase, quartz, bisilicate, and epidote; also of tonalit, gneiss-granite, gneiss, greenstone, limestone with streaks of pyroxene and epidote, calcareous spar, quartz, clay, sandstone, and slate.

In the way of mammals were to be found wild yaks, wild goats or sheep, deer, antelopes, marmots, hare, skunks, foxes, wolves, lynx, panther, and Tibetan bears. And of birds there were white and brown vultures (*Gyps himalayensis* and *Vultur monachus*), the lammergeyer (*Gypaetus barbatus*), the golden eagle (*Aquila daphanea*), the hawk (*Tinnunculus alaudarius*, *Pterofalco Hendersoni*), owls, brown owls, and occasionally even kites; also the black raven (*Corvus corax*), the Alpine jackdaw (*Fregilus graculus*, *F. Alpinus*), wild pigeon (*Columba rupestris*), two kinds of hill turkey (*Tetraogallus thibetanus*, *T. Kozłowi*), wild partridge (*Caccabis chukar*), mountain finches, jays (*Rodoces humilis*), blackbirds (*Petrocincla saxatilis*), *Accentor fulvescens*, *Motucilla*, *Dudytes citreola*, *Pratincola maura*, red-tails, peewits, martins, hill swallows, and many others.

The flowers only begin to bloom in the beginning of summer. On entering the Nomokhun nullah we found, on the narrow patches of green meadowland and amidst the thick brush-like grass, just opening out, yellow dandelions (*Leontodon*) and two kinds of silverweed (*Potentilla anserina*). By the banks of the stream were lagotis, and somewhat farther from the water, on the bare, dry, stony soil, termopsis; alongside of this was the tiny *Malcolmia*, and on the same grassy patches near the rocks, where the full warmth of the sun is felt, grew the beautiful iris.

Some 10 versts higher up the nullah, in small re-entrants, we came across white potentilla, artemisia, androsace, pink draba, and bright yellow, sweet-smelling gades. Still higher and on damper soil were carex, and growing amongst them the small blue gentiana. In places the ground was yellow with ranunculus and three sorts of iris—two lilac-coloured or blue and one yellow.

During the next day's march, we saw growing in the more tempting side nullahs clumps of very small primula, with pink petals. Here and there amongst these dwarfs towered others, tall and full of sap, with greyish-green leaves and pinky-lilac, sweet-smelling petals. There were various kinds of grasses, more

* In length not more than 100 versts; i.e. from the stream Nomokhun-khoto on the west to the river Egrai-gol on the east.

ranunculus and polygonum, just in flower. These were along the bottom of the nullah. On the clay hillsides grew three kinds of astragalus, and a tiny euphorbia which literally covered the small mounds of earth thrown up by the burrowing of marmots. We found large quantities of the above flora on the sunny or south-west side, and amongst the rocks was found the first and only specimen of the *Rheum spiciforme* in flower, as well as the *Gnaphalium leontopodium*.

Higher in the hills we came across the *Przewalskia tangutica*, the former handsome iris, pretty yellow pedicularis, ranunculus, two or three saxifraga. The three last, i.e. pedicularis, ranunculus, and saxifraga, grew near water. On clay, broken hillsides was the yellow corydalis just coming into flower, alongside of the ephedra and light lilac-coloured astragalus. On soft grassland amongst resplendent primulas was the *Adonis cœrulea*. The great cold coming every now and then had prevented the gentians and violets from flowering earlier. On the southern slope the flowers were poorer and less developed, owing to the colder mountain air; but at the foot of the hills on the southern side, in sheltered places, we found one or two sweet-smelling stocks (*Cheiranthus*).

We reached the northern foot of the Burkhan-Buddha range the first evening, and on the second the Noyon-bulak (spring), where we had arranged to meet the Baron-dsaseak. Here we made our final preparations, and got together a flock of some seventy sheep before proceeding further. After passing some nomad Mongols, the expedition reached an excellent camping-ground, where grazing was plentiful; and here we decided to stay for the best part of a week, so as to learn more about these hills and get better acquainted with our animals. This comparatively long halt was all to the good, as it accustomed our breathing-organs to the rarefied air. For our new companions this was especially necessary, as the weakest of them at this high altitude suffered considerable discomfort for the first few days, after which all went well, and we were able to make numerous excursions to the adjacent uninhabited nullahs. The hill flora daily began more and more to awaken, and consequently to enrich our collection. On reaching the hill Laduigin, our indefatigable botanist, seemed to be rejuvenated, and spent whole days in the nullahs, carefully searching them. Kaznakoff, who was also an expert collector, amused himself getting together a quantity of invertebrate specimens, and seemed thoroughly to enjoy filling jars and bottles with the various kinds of mollusca, beetles, and flies, which were unknown to him, not to mention lizards and snakes. Teleshoff was equally in his element shooting birds and animals peculiar to Tibet. In fact, with our arrival in the hills a mantle of energy seemed to have fallen upon the members of the party, and it was to no vain purpose that the south had so loudly called us from the Tsaidam's inhospitable waste.

We were still obliged to keep our huge, fierce mastiff Garza on the chain, for fear of its attacking the Mongols, including even its former owners. Since it had got to know us it would attack all of them, except those of the Buriats who now and again wore their national costume. The strength of the beast was marvellous. Once when barking excitedly at some intruder it dragged about after it the heavy ammunition-box (2½ poods) to which it had been fastened during the day, pulling it from place to place. At night we used to let it loose, and the Mongols had, in consequence, to be careful where they went.

But, alas! a cloud soon darkened our pleasant pastime in the surrounding hills, in the shape of the serious illness of our Chinese interpreter. With each day he grew thinner and paler, so that, much against my will, I was at last compelled to send him first to the Tsaidam, in charge of the Baron-dsaseak, and afterwards when convalescent, to his own town—Sining Fu. I discovered later that this invalid (Li, as the Chinese called him) was a great trouble to the dsaseak,

compelling the latter to produce whatsoever this licentious Chinaman desired to indulge in.

At dawn on May 27—a clear, frosty morning—we recommenced our march, and by nine o'clock had succeeded in crossing the Burkhan-Buddha. The ascent to the pass was steep and stony, and the top covered with a deep layer of snow. The height of the pass—Nomokhun-dawan by name—was, according to my aneroid, 16,030 feet. The neighbouring peaks, towering one above the other amongst the eternal snows, seemed to be thousands of feet higher. The caravan made good time in reaching the summit, with the exception of one of the camels, which we were obliged to lead back and to leave to its own devices on the first patch of flat grazing-ground we could find, till our Mongols should return to the Tsaidam. From the Tsaidam, which was enveloped in a yellowish-grey haze of dust, a piercing wind was blowing, and the temperature was $5\frac{1}{2}^{\circ}$. Fleecy bits of mist, becoming detached from the remainder, wandered amongst the higher peaks, and turning into black, leaden clouds, every now and again burst into sleet. Towards Tibet the weather looked most forbidding. The sky was overcast, and the dark yellow hilltops, buried in the clouds, had the appearance of being wrapped in cotton-wool. Near the summit no animal life was visible, and such vegetation as grew seemed benumbed with cold. It was only when we descended on the southern side of the range that we came upon a stream, free from ice, whose green banks were a relief to look upon. Here we found quantities of wild-yak bones, and from their enormous size it was evident that the animals were unusually large. We were not fortunate enough to come across any of these beasts, though recent traces of a large herd on the soft clay soil clearly pointed to their frequenting the locality. In the course of the day we saw a bear, as well as a small flock of wild goats or sheep.

The following morning we found it fairly cold at our camp at Shara-beilchir, the thermometer showing the minimum temperature at sunset had been 13.5° below zero. The stream had dried up, leaving a glistening icy crust behind it, but nevertheless, after an hour or two the rays of the southern sun began to warm us. The onward path lay in a south-westerly direction towards the Alyk-nor lake, which feeds a stream of the same name that flows eastwards till its junction with the Egrai-gol. On climbing the next ridge we saw a large valley, and close to us a wide strip of water shining in the sun. A little later the lake itself came into view, and beyond it, in the grey distance, the Burla-Abgai hills. In the south-east stood out the Amnen-kor range of mountains. These, like the Burkhan-Buddha, which we had just crossed, had a covering of snow on the summit. In addition to these principal ranges, there were quantities of smaller hills running away to the south and filling in the whole distance to Tibet, which here had an average height of 13,000 to 15,000 feet.

After a couple of hours we reached the north-east shore of the Alyk-nor, where we selected a soft green patch of ground on which to encamp. Messrs. Kaznakoff and Laduigin, taking advantage of the fine weather on the first day (May 28), went out on the lake in our boat to ascertain its depth. The greatest depth was 15 sajens by the steep bank at the southern end, the shallowest part being off the low bank at the northern end. From the northern shore the lake became gradually deeper for some 7 or 8 versts, and only when within a verst of the southern bank did it suddenly become shallower again.

The men went out to shoot antelopes (*Pantholops Hodgsoni* and *Procapra picticauda*), which were to be seen grazing here and there in the wide valley. A herd of wild asses (*Asinus kiang*) were seen across the stream opposite our camp, and on the other bank of the lake was a large herd of wild yaks. The fabulous quantity of wild mammals to be found everywhere in north-east Tibet can be accounted for by the almost complete absence of their worst enemy—man.

Birds, both swimming and wading, soon made their presence on the lake known in the profound silence of the evening. Grey Indian geese, ducks, divers, pintail, redbill, crested mudsuckers (*Sterna hirundo*), handsome widgeon, egrets, plover (*Charagrus Mongolicus*), red-legged water-hens (*Totanus Calidris*), sandpiper (*Tringa Temminckii*), and black-necked cranes (*Grus nigricollis*). Close to the shores of the lake or on the stream we found the long-tailed eagle, fish-hawks, falcons, black-eared kites, ravens, larks, jays, finches (*Pyrgilauda ruficollis* and *Onychospiza Tuzanowskii*), swallows, and a few others.

On the second day of our halt by the Alyk-nor, I set out early in the morning to make a rough sketch of the lake, taking with me Badmajapoff and Badukshanoff, as well as one of the Mongols. We all rode, carrying only what was necessary for a shooting trip on our saddles—a teapot, cups, and a few eatables. The weather was glorious—calm and clear. The sky above was marvellously blue, and we could, thanks to the transparency of the air, make out distinctly the most distant objects in the valley. The lowlying shore along which we at first rode was uniform in shape. Sand-banks projected from the water, forming islands, which served as an asylum for the birds. In places we came upon springs, fringed with green, on which wild asses and antelope were feeding. But what interested us most were the bears, whose fresh tracks had been noticeable as soon as we left camp. They had apparently passed the night on the higher ground, moving down at daybreak to the shore along which we were riding. While I was busily employed trying to sketch the banks and put in the shade of colour on the top of the water, as well as to sketch the birds swimming about on it, my companions amused themselves watching the various herds of animals wandering by the shore. The bears were soon sighted, and we could with the naked eye easily distinguish the powerful build of the male compared with smaller dimensions of his mate. Now that they were in our path, the temptation to go after them was irresistible. As we got nearer we saw that they were playing, and that it would consequently be easy to get close enough for a shot at them.

Leaving the ponies, Badmajapoff and I went after them with the cunning of experienced hunters. Not a sound disturbed the deathly stillness of the morning air. Dust, raised by a footfall, fell whence it had risen, and there was no reason to fear that our quarry would scent us. When, however, we reached the patch of level ground on which they were disporting themselves, we were at once perceived. Bruin instantly stopped playing, and, raising himself on his haunches, looked intently in our direction. His mate shuffled up to him, equally alarmed. For the moment they might have been statues, but quickly arranging which animal each was to take, we fired simultaneously. My bruin fell heavily on the sward, while the she-bear appeared to do the same; but quickly getting up, she almost unnoticeably slipped off the green and disappeared. When we came up to the other—the dead bear—she had already gone some distance, but with the glasses we could make out her quick shuffling gait and occasional halts, as the poor frightened beast looked back in our direction. My companion mourned her escape, but I endeavoured to console him by saying that in the future months he would have many a chance of correcting his mistake and proving to us his marksmanship.

Having skinned our victim and fastened his coat to one of our saddles, we were ready to move on, when suddenly I caught sight of another large old bear coming quietly towards us from a neighbouring marsh. While I was wondering what was best to be done, he came closer and closer, as if purposely making for us, until he was within 400 paces. Slipping off my pony, I quickly went to meet him, and when within about 120 paces, dropped him like a log with a couple of bullets from my Berdan rifle. His skin, like that of the first, was in excellent condition, so

we lost no time in removing it. Inside him we found some eggs, probably those of birds whose nests he had pillaged in the marsh. The stomach of the first bruin, which I had killed in the middle of his game of play, had been quite empty.

Having tied the second skin to one of the saddles, we lost no time in pushing on towards the foot of a small hill, Tologinin by name, where by the bank of a clear running stream, flowing from a north-westerly direction into the Alyk-nor, we called a temporary halt. With the dry wood and grass around us, we soon had a nice fire burning, on which we roasted meat and boiled water for tea. Our appetites that morning were indeed to be envied, for we were as hungry as the proverbial hunter. The ponies we let loose, and they revelled in the green pasture land. The weather was perfectly glorious. Not a cloud was to be seen in the pure blue sky, and the rays of the sun, now high in the heavens, were perceptibly warmer. Lying on my back on the soft velvety grass, I gazed upwards into the wonderfully azure sky, and high above me in the blue I could distinguish wandering birds of prey—vultures—from whose sharp eyes the carcasses of our victims had not long escaped. These rovers of the air moved towards the direction of their booty, and then swooped downwards like veritable bombs. Taking up my glasses, I looked at the place where we had left the dead bears, and saw a wild ass come up to one of them, walk round it, and then, stopping with his head erect as if suspecting something, suddenly dash off at full speed. The feathered scavengers were still moving towards one central point—their booty—where a glorious feast awaited them.

After finishing their tea, my companions set to work improving the skins by scraping off the thick fatty tissues,* which, as we threw them aside, served to entice one of the white vultures. It swooped down quite close to us; but for its daring impudence this winged robber forfeited its life, being bowled over by a bullet from one of our military "three-line" rifles. Its plumage was so beautiful that we kept it for our collection. Later we continued our journey round the lake, keeping for as long as possible close to the shore. The western end was much intersected by small streams falling into the lake and forming between them ponds and pools, which made movement both difficult and slow. Avoiding a bog, we got on to what was evidently an animal track, winding about on gravel soil and gradually, almost imperceptibly rising, bringing us on to the high shore of the lake, whence we could see the valley lying before us in all its beauty. On the glistening surface of the water the huge peaks of the Burkhan Buddha were reflected as if in a looking-glass.

Having killed some shore swallows (*Cotile riparia*) which were flying over the rocky shore, we continued on our way. Shortly afterwards we saw a herd of wild asses coming towards us from the near hills, and they were brave enough to approach within fifty paces of us. I studied them intently through my glasses, but in their large deep eyes could detect no sign of fear—only curiosity. However, we were obliged to push on, and as we moved forward they at once took fright. They raised their heads high, snorted loudly, and then turning round quickly galloped off, kicking at one another as they went. When on the move the wild ass carries his head proudly erect, and waves his short tail from side to side. On our way to camp by the eastern shore of the lake we passed a great number of them, and in addition several antelopes, whose beautiful shape and graceful build, the size and carriage of their horns, as well as their quick and curious gait, called forth remarks of admiration and astonishment from my young companions.

* It is only possible to skin animals roughly when out shooting; the actual cleaning and curing of trophies is done in camp.

We were so busily occupied in watching the various animals that we imperceptibly approached our camp, to the east of which (and on the left bank of the stream) Ivanoff and some of the cossacks were waiting to show us the best crossing. A few more minutes and we were in. With splendid appetites we tackled the mutton and drank our tea, describing to the others what we had seen and done.

The Alyk-nor lies in an open valley, bounded to the north by the Burkhan-Buddha range, and to the south by the Under-Kuku hills. Although nearly 40 versts in circumference, this fresh-water basin seems comparatively small, owing to the gigantic scale of its surroundings—the Tibetan mountains. Its height above the sea is 13,370 feet. Its greatest length, which is by the lowlying shore at the north end, is 15 versts. Its other measurements have been already given. The colour on the top of the water was very variable, depending on the condition of the surface and the light. If the water were calm, the surface smooth, and the sky cloudless, the lake seemed steely-blue. Under opposite conditions its colour was monotonously grey, varied only by occasional dark shades.

As regards ichthyological fauna, the lake could boast of but few varieties, though it was literally crammed with fish. The great quantity of them, as well as in all the lakes, rivers, and streams of Tibet, is undoubtedly due to these waters having probably never been fished since the beginning of the world. We kept the following specimens from the Alyk-nor for our collection: *Schizopygopsis thermalis*, *Sch. malacanthus* and *aphua* (*Nemachilus Kunyessanus*, *N. Grassus*), of which, according to Prof. A. M. Inkoylsky, of the Kharkoff University, the latter is a new species.

The foreshores of the lake were covered with a grassy vegetation. The lowlying ground was dotted with green patches, on which were small reeds, blue and yellow iris, primula, and saussurea; and amongst them the common shrubs (*Myricaria Prostrata*) so typical of Tibet. The flora to be found on the northern shore of the lake were richer and more varied. In a stony nullah close under the hill we came across crimson milk-vetch (*Astragalus scythropus*), while here and there was sweet-smelling stock (*Cheiranthus*), and in the narrower clefts under the cliffs were more of the common shrub (*Myricaria prostrata*). Their leaves appeared paralyzed with the frost, and broke off the moment one touched them. Amongst them the pedicularis was struggling to come into flower. Near the myricaria, as if thrown there, was the green rose (*Saussurea*), of which some of the preceding year's tall bushes were still in flower. On the top of the steep cliffs was the corydalis, and lower down the euphorbia. A somewhat less common plant was the *Przewalskia tangutica* with yellow petals, and growing on the dry clay slopes were wild tea bushes and eurotia.

The stream Alyk-noring-gol, flowing out of the north-east corner of the Alyk-nor, runs in an almost west-to-east direction, corresponding to the trend of the hills and the valley which they enclose. At first narrow and of a yellowish clayey colour, this stream as it moves eastwards widens and becomes clear from the rapid silvery waters of the brooks tumbling into it from the neighbouring Amnen-kor range, which is the western prolongation of the still larger range Amne-machin ("Grey-headed Grandfather"). The length of this stream till its junction with the Egrai-gol (on the left bank) is about 80 versts, and the force of its current was fairly strong.

The Alyk-noring-gol valley, narrowing in places to a width of five versts, and in others opening to nearly double that width, is rich in pasture land, and affords ample grazing for wild animals. The Tsaidam Mongols go there every year to hunt wild asses, antelopes, and wild yaks. The vegetation at the lower end of the valley is little different to that by the lake. The further we proceeded eastwards the greater

quantities of static, *Przewalskia tangutica*, and eurotia were visible; along the streams rising in the Amnen-kor *Hyppophæ rhamnoides*, *Potentilla fruticosa*, were abundant. Amongst the yellow and lilac-coloured iris mentioned above was the *Iris tigrida*, which eventually took its place. This had large beautiful flowers. By the marshy edges of pools we found *Ladotis*, and a little higher *Thermopsis alpina*. Here and there was the *Myricaria prostrata*, but it was more scarce than formerly, and consequently finer. There was also the greenish-yellow slipper, the small low-growing ephedra and the *Lasiagrostis splendens*; the latter we found along the sides of the valley close to the hills. Amongst the *Hyppophæ rhamnoides* grew clematis (*Clematis Orientalis*) and the tiny sweet-smelling honeysuckle (*Lonicera*), and along the branch streams rhubarb (*Rheum spiciforme*). Under the hill on the southern side of the Burkhan-Buddha range there were quantities of stock (*Cheiranthus*) with yellow and reddish-brown flowers, deeply rooted amongst the stones. By the marshes along the northern foot of the Amnen-kor various kinds of herbs and other grassy plants were growing, among which was the primula and golden-yellow bachelor's button (*Ranunculus*).

At the confluence of the Alyk-noring-gol and the Egrai-gol we met for the first time the nomad Tanguts belonging to the Aimak Rangan. They were living in a small number of "banuiks," called by the Tibetans "banags."

After traversing almost the entire length of the Alyk-noring-gol valley, we left it near the Kuku-bulak (spring), entering one of the northern nullahs of the Amnen-kor, which we were obliged to cross so as to be able to proceed on our journey south. At first this nullah seemed quite attractive, but as we moved up it the view became wilder, the ascent stonier, steeper, and narrower; even the path was sometimes invisible, and before we had been on it long, Jeroy—one of the Mongols who was invaluable as a shepherd in charge of our animals, though worthless as a guide, for which purpose he had been given to us by Baron delessak—was, to our disgust, obliged to confess his ignorance as to the road. As soon as I heard this I ordered him to proceed in rear, and trusted to my own instincts and the knowledge which I had acquired in my prolonged wanderings to enable me to guide the party.

The first day of our stay in the Amnen-kor hills, June 6, was remarkable for the great cold, coupled with the quantity of snow which fell in great heavy flakes from early morning till noon, covering the ground with a thick layer more than a foot deep. As we slowly ascended, the feathered inhabitants of the higher hills—mountain finches (*Leucosticte hæmatopygia*)—flew down the centre of the nullah, and with shrill cries crossed from one side to the other, now and then settling close to the passing caravan. Amidst the noise of their cries I soon heard others—sweet, delicate, soft sounds—quite new to me, and which at once attracted my attention. After a few minutes I was astonished to see on the nearest rocks, as well as on the grass-covered slopes, some very beautiful birds which it was not difficult to recognize as the *Leucosticte Roborowskii*, discovered on the late Prjevalsky's last journey in the Burkhan-Buddha mountains, and which I had for some time hoped to come across in this part of the Tibetan hills. M. Prjevalsky's expedition succeeded in securing only one specimen of this bird, in spite of making a special trip in order to try and get a hen bird (they had already got a cock). And here, sixteen years later, I again saw them, both single birds as well as in coveys, amongst which were both the red males and the smaller grey females. At first I only gazed at them longingly from afar, but within half an hour I was holding two dead birds in my hand, and involuntarily I remembered our celebrated ornithologist V. L. Bianky, who on saying good-bye to me had expressed the hope that I would secure a specimen of this bird, describing the grey colour, which was then more or less a guess. From the specimens in the Zoological Museum of the Imperial

Academy of Science, the above-mentioned zoologist has been able now to recognize a new species, the *Kozlowia* (*Kozlowia Roborowskii*).

Delighted at getting such valuable trophies, I had quite forgotten the unpleasantness of the weather. It was now mid-day. The snow was no longer falling, but the brilliant glare of the glittering snow in the sun hurt our eyes. As the khainiks were tired and our yaks required a rest, we were obliged to halt and ease them for a time of their heavy loads. The neighbouring rocky peaks, towering above the ridge, at times were visible, and again at times were hidden from our view by the moving clouds which wandered picturesquely amongst the mountains. After rather a steep ascent we reached the stony, razor-like ridge. The heavy snow which had fallen, though making movement difficult, enabled us to follow the zigzags, and we at last reached the centre of the pass—height 15,990 feet. The highest peak was some 700 or 1000 feet above it. On neither side of the pass was there any view to be had. To the north it was snowing heavily. To the south was another range of hills. As this route is never used by natives, the path we followed must have been made by animals—wild yaks and asses. The descent down the northern side of this nameless pass was steeper than the ascent, and we were therefore all the sooner at the grassy bottom of the nullah, though obliged to lead each of the bulls so as to prevent them slipping. When darkness came on we decided to bivouac where we were, and we were then able to rest after all the discomforts of the day. We were so worn out that a bear, coming almost into our bivouac like an unexpected guest, was allowed to depart of his own free will. Taking every advantage of his luck, he proceeded along the bottom of the nullah, from bottom to top, and, passing an overhanging rock, leisurely stood up on his hind paws and carefully scratched his back against the rugged projecting boulder.

Next morning, proceeding downwards along the nullah and gradually inclining to the north, we reached a pretty piece of ground surrounded by rocks dotted with shrubs, and close to rich grassland, which enabled us to halt four days with the greatest benefit to our animals. From here two expeditions were made, one by myself to reconnoitre the pass leading over the principal range to the south, the other by Kaznakoff to the north, in order to buy some transport bulls from the nomad Tanguts, and, if possible, to procure a reliable guide. Laduigin and Teleshoff scoured the neighbouring rocks in search of specimens for their collections.

Early on June 9 Kaznakoff and I left camp almost simultaneously. At first I followed the same nullah by which we had arrived, but after a little got into a steeper one leading towards the summit of the southern range. As a rule I preferred riding to walking, and as we went along I carefully scanned the rocks and the grass patches between them for life and flowers. Musk-deer were to be seen grazing, but they scampered off over the rocks as soon as they noticed us. A little further on we saw a herd of wild asses down in the valley, while high above the hills we now and again saw the ubiquitous vultures. The sun rose sluggishly, little by little lighting up the side nullahs, and instead of silvery hoar frost the grass was covered with glittering drops of dew. Hopping about on the boulders were large handsome mountain finches (*Pyrhospiza longirostris*), *Carpodacus rubicilloides*, *Accentor fulvescens*, *A. ruberuloides*, and other small birds, brightening the summer morning with their songs.

As we neared the pass we came across a red bear, which was so occupied with his own affairs that he never perceived me coming up to him till a couple of bullets laid him low. The sound of the shots echoing loudly among the rocks quickly attracted the vultures, who from the near crags had been watching our movements. My companions on this expedition were Jarkoy and Dadai. Having skinned the bear and tied the trophy to one of the ponies, we were about to proceed on our

journey when a vulture swooped down so close to me that I had to slay him, his body falling close to that of the bear. As soon as I fired all his winged companions flew up from the rocks, and, circling over the dead bodies, settled again in their former places. But I was surprised to notice that even when we had proceeded some distance they still refrained from approaching the dead bodies. Meanwhile we had neared the pass. The snake-like path wound about the steep slope and crossed on to more accessible ground, where we saw our pretty friends the finches (*Kozlowia Roborowskii*), and halting for a few moments I shot a couple of them. Another half-hour and we had climbed to the top of the pass, whence we eagerly scanned the broad horizon to the south. In front of us was a typical Tibetan hill, down which the descent was considerably steeper than the ascent which we had just made, and almost in the centre of the panorama before us, glistening amongst the greenish-yellow velvety foothills, lay the watery expanse of the Oring-nor. Beyond this fairly large lake, in the blueish distance, rose the wall-like ridge of snow-capped mountains which give birth to the Yellow and Blue rivers. The rarefied air was remarkably transparent, so much so as to mislead us with regard to the distance of the lake, whose shores we could so clearly see. For long I was unable to tear myself away from this wonderful picture, presenting so striking a contrast to the view on the northern side, where the ground fell away in precipitous wild-looking gorges divided by sharp-ridged spurs.

Being sufficiently satisfied with our knowledge of the road, and after fixing the height of the pass as 15,780 feet, we commenced to retrace our steps along the morning's path, zigzagging about across the narrow strips of snow lying on the northern side of the hill. Soon, on a projecting rock, I saw a second red bear, smaller but similar to that which I had killed earlier in the day. They were evidently a pair, and this was now the widowed female searching for her mate, but she was wise in time, and so avoided following him on his unknown distant journey. On the moist edges of green plots we were again lucky in securing specimens of the mountain finches, which were on this occasion together with the *Leucosticte hema-toppygia*. Proceeding on to where the dead bruin lay, we found, to our surprise, that the body had not been touched by the vultures, which had now collected in countless numbers. The reason was, doubtless, the presence of the dead bird lying alongside; so to see what would happen, we amused ourselves by removing its body some hundred paces, when we were rewarded by seeing its companions immediately swoop down one after another on to the dead bear and commence their feast. Fighting over the body, those huge birds attacked each other with beak, talon, and wing, filling the air with their curious discordant cries. To dismount and fire into the brown of them with my "three-line rifle" was the work of a moment, whereupon away they flew, with the exception of six, which had breathed their last. Of the bear little remained. Taking home for our collection a pair of the best specimens of this (*Gyps himalayensis*), we finished our sport for the day, and, as the sun had already sunk below the horizon, we made tracks as quickly as possible for camp.

Kaznakoff had already returned with some nomad Tanguts, from whom he had luckily been able to purchase three transport bulls and some butter. We gave them two of the most tired of our khainiks, which we hoped to be able to pick up again at the Tsaidam on our return journey, and we persuaded one of them, who professed intimate knowledge of the neighbourhood, to accompany us as a guide. In the course of conversation with him regarding the route, I learned that the pass which I had discovered was really one of the best over the Amnen-kor range,*

* Some 10 versts to the east of the pass which we crossed is another, called the Karu-gol, which is equally accessible.

leading into the valley of the Hwang-Ho, or Ma-chu river, as it is called by the Tibetans. It is also known as the Yellow river.

The Amnen-kor range, as has been said above, is the western continuation of the Amne-machin. In length about 100 versts from west to east, and in breadth about 80 versts, this range consists towards the west of two chains of peaks, towering among the eternal snows. We determined the level of the snow-line here as about 16,170 feet above the sea. From the Tibetan side we only were able to see these lofty snow-capped peaks on the western half of the above range. Generally speaking, the Amnen-kor appears much less imposing from the south than from the north. The northern slopes of the Amnen-kor, being usually under snow, feed a number of small streams belonging to the Tsaidam basin. The southern side gives rise to one or two, whose waters fall into the Hwang-Ho, which itself runs into the Pacific ocean. With regard to the indefinite expression "one or two," I should mention that one stream was reconnoitred by us, and is accordingly shown on the map. It rises in the western and higher part of the Amnen-kor, and, *en route* to the Yellow river, receives on its left bank several streams, which flow from the nullahs further east. As the eastern portion of the Amnen-kor is still unknown, one can only guess as to the existence of other streams. The flora and fauna of this range are, generally speaking, much the same as those on the more northern portion of the Burkhan-Buddha.

(To be continued.)

EXPERIMENTS ON THE TRANSPORTING POWER OF SEA CURRENTS.*

By Dr. JOHN S OWENS

THE great differences of opinion which exist as to the relative importance of wave and current action in moving material upon the foreshore or sea-bed show the necessity for some experimental investigation of the subject. It is one of great importance in connection with the study of coast erosion, and, furthermore, it is one which is beset with many difficulties and pitfalls.

The experiments about to be described, while only touching the fringe of the subject, will, I hope, give rise to some discussion from which valuable information may be obtained; and as the matter is one pre-eminently suited for research, the opinion of the members upon the lines along which this should run will be valuable. These experiments were made last August, on the coast of the Wash, near Holme, Norfolk, where there is a fine stretch of sands exposed at low water; and, owing to the existence of several large pools or swills left by the receding tide, currents of varying velocities could be obtained near the outlets of these pools into the sea. I wished, in the first place, to find out, by actual trial on a natural bed, what sized stones a current of a certain velocity could move.

The method adopted was as follows: Having procured and numbered a series of flint stones ranging in size from half an inch to 6 inches in diameter, I found a suitable current, and placed these stones one by one on the bottom over which the current was flowing, until the size was found which the current was just able to move, the next size above being refused; the number of the stone was then noted. The next step was to measure the velocity of the current. This was done by driving two stakes into the bed a measured distance apart, and timing the travel of a float

* Research Department, November 15, 1907.

between. It was possible to get the velocity with great accuracy by this method, the observation being repeated several times as a check. The results of these observations are set forth in the accompanying table.

During the course of the experiments several curious points became apparent, the most noteworthy, perhaps, being the extraordinary governing power which sand exercised when present in any quantity. The ordinary sand of the seashore commenced to move under the influence of a current of 0.85 f.p.s., the movement being in the form of the well-known sand ripples; at all velocities up to 2.5 f.p.s. these ripples remained well marked, but at about the latter velocity they were always swept away, and sand movement continued in a smooth sheet along the bottom, the rate of the movement being suddenly and very greatly accelerated. So, then, between 0.85 and 2.5 f.p.s. ripple-marks on a sandy bottom remain well marked. Now, turning to the table, it will be seen that as long as such ripple-marks existed on the bottom, the movement of each stone was arrested in the hollows of the ripples: that is, although the current was strong enough to move a stone on a smooth sandy bottom, it was not able to lift it out of the trough between two sand-ripples, hence the stones invariably stopped there. A current, therefore, of say 2 f.p.s., which had force enough to move a stone of nearly 2 inches diameter, was prevented from doing so, except for a very short distance, by the ripple-marks. The first instance of continuous movement recorded in the table occurred at 2.5 f.p.s., when the sand was moving in a continuous sheet and all ripples had been swept away. It would thus appear that where sand exists in quantity, all currents, up to 2.5 f.p.s. or 1.7 mile per hour, are ineffectual in moving shingle, whereas at about 2.5 f.p.s. the current suddenly acquires the power of moving stones up to nearly 3 inches in diameter over a sandy bottom.

The presence of even slight hollows or irregularities in the bottom, or of large flats upon the stone, had always a great influence upon the transporting power of the current. The effect of either of these was always to arrest the movement of the stone, unless the velocity of the current was greatly in excess of that required to move it; and if the bottom was sandy, such stoppage invariably resulted in a gradual sinking and burying of the stone in the sandy bottom, so that, should the current subsequently increase in velocity, it could not dislodge the stone until the sand had been swept away. The inference which this appears to justify is that, since the sea-bottom is nearly always irregular, and stones are seldom perfect spheres, the effect of currents alone, unless of exceptional velocity, is chiefly limited to the transport of fine matter, such as sand and mud.

The above conclusion is further supported by some other facts which came to light. Referring to experiment No. 1 on the table, it will be noted that the bottom over which a stone of 1.9 inch diameter was rolled by the current consisted of fine shingle of a quarter to half an inch diameter *at rest*. This is curious, for here we have a current moving a stone nearly 2 inches in diameter, but unable to move shingle one quarter inch in diameter.

Again, referring to experiment No. 13, where a stone about 5 inches diameter was rolled over a sandy bottom. I throw into this current about 6 lbs. of fine shingle, and it remained for some time in a heap on the bottom, particles moving away at intervals from the edges, and eventually most of it was buried in the sand and remained there. It is clear, therefore, that here is another complicating feature: From the movement of shingle particles over a smooth bottom, we cannot infer that the same current would move them from a mass of similar particles. Each particle derives support from its neighbours, and, further it is sheltered from the full force of the current; in fact, the patch of shingle behaves somewhat like a very thin flat single stone lying upon the bottom.

TABLE
GIVING SIZE OF FLINT STONE MOVED BY A CURRENT OF SEA-WATER.

No	Nature of bottom.	Velocity of current.		Shape of stone	Diameter of stone (average in inches).	Weight of stone in pounds.	As calculated from formula		Nature of motion of stone.
		Miles per hour.	Feet per second.				Diameter in inches.	Weight in pounds.	
1	Rippled sand	0.91	1.33	Irregular cube	0.5	0.0156	0.80	0.025	Rolling, stopped in hollows of ripples.
2	Rippled sand	0.92	1.35	Ditto	"	"	0.83	0.028	Ditto.
3	Rippled sand, soft	1.20	1.76	Nearly spherical	1.7	0.266	1.41	0.14	Ditto.
4	Fine shingle, $\frac{1}{4}$ " to $\frac{1}{2}$ "	1.36	2.00	Slightly flattened sphere	1.9	0.36	1.82	0.30	Rolling, but stone stopped in slight hollow in bottom. Shingle on bottom at rest.
5	Rippled sand, very soft	1.50	2.20	Irregular sphere	1.2	0.14	2.20	0.53	Rolling, stopped each time in hollows of ripples.
6	Fine sand moving in a sheet not rippled	1.70	2.50	Ditto	2.8	1.20	2.85	1.15	Rolling, motion steady and continuous.
7	Sand moving in a sheet, not rippled	1.84	2.7	Ditto	"	"	3.34	1.79	Ditto.
8	Very smooth, slippery clay	"	"	Ditto	"	"	"	"	The largest stone moved by sliding, all the smaller stones rolled along.
9	Sand moving in a sheet, not rippled	"	"	Irregular oval	3.5 and 4.75	2.44	"	"	Rolling, continuous.
10	Smooth peat	2.04	3.00	Ditto	"	"	4.20	3.70	Rolling, continuous; stone not covered by water. It was largest to hand; current would move larger stone.
11	Sand moving in a sheet, no ripples	2.18	3.20	Irregular sphere	2.8	1.2	4.65	5.025	Rolled continuously 32 feet.
12	Ditto	2.25	3.30	Irregular, with large flat faces	7.5 long, 4.2 x 3.8 in diameter	6.88	4.95	6.06	Rolled short distances of 1 or 2 feet, then stopped on a flat and gradually sank in sand.
13	Ditto	2.38	3.50	Ditto	"	"	5.50	8.31	Ditto.

As it is with the transport of large masses of material we are chiefly concerned, here again appears a reason for thinking that, as a rule, currents alone are ineffective in moving shingle or larger stones, and their action chiefly limited to the transport of sand and mud.

As to the method by which a stone is moved by a current, in practically all cases the stone was rolled over the bottom and not dragged along. The only exceptions to this rule were one case of a stone on a very smooth slippery bottom, made so artificially; and the other, that of stones having strands of seaweed attached—the streamer of weed preceded the stone and prevented it from rolling. I tried a series of flat stones, having the largest diameter from 2.54 to 3.25 times the smaller, and in all cases they tumbled over and over in the current, when it was strong enough to move them.

While making this experiment, I noticed a curious thing. On throwing one of these stones into a swift current flowing over a smooth peat-bed, it rolled irregularly for a moment or so, and then got up on its edge and was carried off by the current rolling along like a wheel; I then tried another, throwing it in as before, and it behaved in exactly the same way; and similarly with the remainder of the stones, about a dozen in all—every one, without exception, got up on its edge and rolled away like a hoop. All these stones were disc-shaped, and this appears to be the normal method of travel of such flat disc-like stones when passing over a smooth, hard bottom.

Turning now to the theory of impact and transport by a current, it may be stated briefly that the diameter of a particle, of higher specific gravity than water, which a current can move varies directly as the square of the velocity of the current and inversely as the density in water of the particle moved. Since the weight of the pebble or stone varies as the cube of its diameter, it follows that the weight of stone which a current can move varies as the sixth power of the velocity of the current. Thus a current of 2 f.p.s. will be able to move particles four times the size and sixty-four times the weight which a current of 1 f.p.s. can move. A slight increase in velocity may therefore produce effects out of all proportion to what would be expected.

I have worked out upon these lines the following formula, which gives approximately the size of stone which a current of a given velocity can move:—

When d represents the diameter in inches of the particle,
 W " " weight of a cubic foot in pounds,
 V " " velocity of current in feet per second,
 then, for the ordinary partly rounded pebble lying on a smooth bottom—

$$d = \frac{45V^2}{W - 64}, \text{ or for flints } = \frac{V^2}{2.2}$$

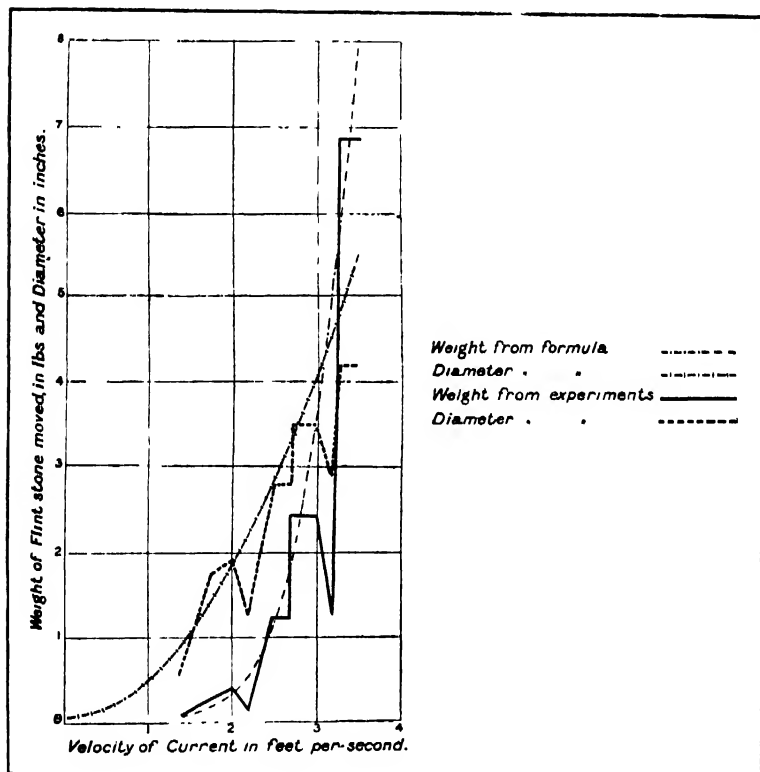
and the weight in pounds will be, if of flint, approximately $0.05d^3$.

There are certain variable factors which make it impossible to find an absolutely correct formula to suit all cases; such are the nature of, and amount of friction on, the bottom, and the shape of the stone; but the above gives fairly accurate results. Included in the table, for comparison, are two columns showing the theoretical diameters and weights of the particles which each current could move, according to the above formulæ. The accompanying diagram gives also the theoretical curves of weights and diameters beside the actual. It will be seen that there is no discrepancy which cannot be explained by the great variation in the conditions under which each experiment was carried out.

Returning now to the movement of sand. The first sign of movement in sand lying in a mass on the bottom became apparent at about 0.85 f.p.s.; now, if we

apply the formula to find the velocity required to move each grain singly, as in the case of the stones experimented with, and taking the diameter of the sand-grains as one-fiftieth of an inch, which they certainly did not exceed, we find that a velocity of 0.21 f.p.s. is sufficient. I have no experiment to check this by, but believe it is fairly correct.

Again, turning to experiment 13, where a current of 3.8 f.p.s. was not quite capable of moving fine shingle of quarter to half an inch diameter, thrown in in a heap. The velocity required to move grains of this diameter singly is about 0.9 f.p.s.



It will now be noticed that in both cases the velocity required to move the grains when in the mass was about four times that required to move them singly. It is not suggested that this ratio holds good for all sizes of particles, but it shows roughly the great influence of the grouping and locking of the particles together.

Considering all the points mentioned, it would seem that on the whole we must regard wave action as being more important than current action as an erosive agency. The correct view of the matter is doubtless that which keeps in sight the constant interaction of these two agencies—the waves being more effective in moving the larger particles of shingle and stones, owing to their sudden and violent action;

and the currents keeping up a steady movement from place to place of the finer sand, and matter which has been suspended in the water by wave action.

That fairly rapid currents exist upon the sea-bed in deep water beyond the limits of wave disturbance appears to be established; but their power, unless they are of very great velocity, is probably limited to the transport of fine mud and sand. Of course, given sufficient velocity, a current can move particles of unlimited size, but these remarks are intended to apply only to currents the existence of which we have evidence of at present.

After the paper, the PRESIDENT: We have listened with very great interest to what Dr. Owens has had to tell us. Perhaps Dr. Strahan might open the discussion.

Dr. A. STRAHAN: I think that this paper contains a large number of valuable observations, and I only regret that the author had not more time at this meeting to do justice to his work. One point interests me greatly, and that is the comparative rate of travel of large stones and small. In the case of the Chisel beach, it is well known that at the east end the stones are large, towards the middle they are intermediate in size, while towards the west end of the beach they are small, and it has commonly been stated that this gradation in size is due to attrition of the pebbles in their travel from east to west. In writing the Geological Survey Memoir I had to sum up the theories which had been advanced on the Chisel beach, and I formed a different opinion. I concluded that the larger pebbles were sorted out by wave-action, and that they travelled eastwards and faster than the small, with the result that they assembled at the east end of the beach. One other point seems to me worth mentioning, that is, that when the Channel tunnel was first proposed, a good many years ago now, the French examined the sea-bottom partly by diving, partly by sounding, and were able even to make a geological map of the bottom of Dover strait. They got a sufficient number of specimens to show that the Chalk and the Greensand crop out in the sea-bottom, and were able to indicate the position of the outcrops. It is clear, therefore, that the current is capable of sweeping away all loose material from a large part of the strait.

Mr. LAMPLUGH: The paper contains much of interest to geologists, and the author has attacked the subject in the right way, but I think that the erosive powers of currents has been underrated. In Holderness there is a rapidly receding coast-line, from which boulder clay and other drifts are being removed in very large quantity. If there were not a removal of this material going on below low water, the tidal platform would be continuous from the place where the erosion first began. But instead, the distance between high and low water is comparatively narrow, and it is quite clear that the low-water line is advancing inland proportionally to the advance of the high-water line. The sea deepens steadily from the land, which proves that erosion of the boulder clay is going on much below the level of low water. Moreover, the material that has been removed is not only sand and mud, but also the boulders which were embedded in the drifts, for if these boulders had not been removed they would soon have formed a protecting layer over the whole of the new sea-floor. The character of this bottom shows that the boulders are moved along beneath the sea, accumulating here and there for a time in patches, leaving other patches of bare clay and smooth sand. The result is important geologically, because the encroaching sea produces, not an absolute plain, but a slope, which is no barrier to its further advance.

The author's observations with regard to the rolling of stones along the bottom, will help to account for deposits, such as the Bunter Pebble Beds, in which stones of considerable magnitude sometimes occur scattered, in a comparatively fine-grained

matrix, and not segregated. One sees how such pebbles may have been set rolling upon a smooth sandy floor till they reached a rippled surface, and then brought suddenly to rest and embedded in sand. I mention this only as an example of the usefulness of the author's work to the geologist, and I hope he will give us further results on the same lines.

Dr. VAUGHAN CORNISH: All who are interested in the action of waves and currents will welcome Dr. Owens' addition to the experimental data which we possess as to the connection between velocity of flow and size of stone moved. He finds that ordinary seashore sand is unmoved below a speed of current equal to 0·85 f.p.s.; that between 0·85 f.p.s. and 2·5 f.p.s. the sand moved in the form of the well-known sand-ripples, the depth of water being from 1 to 5 inches; at 2 f.p.s. shingle on the bottom remained at rest; but that at 2·5 f.p.s. the current suddenly acquired the power to move *continuously* stones of nearly 3 inches in diameter and 1·2 lb. in weight, in a stream 3·5 inches deep. My own hitherto unpublished measurements in currents of similar depth on the Dorset and Norfolk coasts yielded results concordant with these observations. I found that in clear streams where the sand was not in the well-known ripples, but only presented small lee-facing cliffs at considerable intervals, the sand was scarcely moved except in a few spots where swirling motion occurred, and that in these streams the velocity was—

Locality.	Velocity.	Average velocity.
Branksome Chine (Dorset)	0·54 f.p.s.	0·37 f.p.s.
Mundsley-on-Sea (Norfolk)	0·60 "	

Velocities in streams showing the well-known sand-ripples about 3 inches in wave-length and occurring in long trains were as follows:—

Locality	Velocity.	Average velocity.
Branksome Chine	1·16 f.p.s.	1·475 f.p.s.
Mundsley	1·49 "	
Branksome Chine	1·50 "	
" "	1·75 "	

The following observations were made in streams in which the ordinary or best-known ripples had been replaced by those which move upstream,* the superincumbent water being moreover turbid owing to sand continuously in suspension. Stones of the beach (smaller, however, than the author's 3-inch pebbles) were often observed to be travelling rapidly on the sandy beds of these streams.

Locality.	Velocity.	Average velocity.
Branksome Chine	2·00 f.p.s.	2·22 f.p.s.
" "	2·12 "	
Mundsley	2·55 "	

The average diameter of the sand-grains at Branksome was $\frac{1}{10}$ of an inch; of Mundsley sand 82 per cent. passed through a mesh of $\frac{1}{16}$ inch, but was stopped by a mesh of $\frac{1}{10}$ inch. It will be noticed that the highest of the above speeds corresponds with that at which Dr. Owens found the sand to travel in a continuous sheet without rippling. I suggest that this effect depends upon a particular state of the current, viz. that it was not fully charged with sand. When saturated it scours, when supersaturated it silts, and when it is picking up just as much as it is dropping it generally maintains some kind of sand-wave.

* *Geographical Journal*, June, 1899. "Kumatology."

In deeper water, certainly, the larger kind of sand-waves, with a wave-length of about 20 feet and height of about 1·5 foot, occur with higher velocities of current; thus at Aberdovey I found these sand-waves were *increased* by a current of 2·93 feet per second in a depth of 3 feet of water.*

Prof. Osborne Reynolds thought that the power of a current to raise sand from the bottom and maintain it in suspension depended on a change from stream-line flow to eddying flow. This, he said, took place suddenly at a critical velocity which was proportional to the dimensions of the channel. Mr. E. C. Thrupp concurred in this opinion, but found that the critical velocity, *i.e.* the commencement of eddying flow, does not set in, in the case of large channels, until a still higher speed is attained than that required by Osborne Reynolds's formula. In large channels, he says, there are innumerable instances where the velocities at the bottom are sufficient, according to mathematical theories, to roll along large cubical boulders, whereas, in fact, they hardly disturb fine sand, and he goes on to say that "No mathematical theories hitherto advanced can account for these critical-point phenomena, because the assumptions upon which they are based have not been ascertained by experiment."

I have now cleared the ground for two suggestions which I desire to make for future experiments: first, I suggest that the rate of settlement through water should be determined for all sand and shingle experimented upon. For the sand at Branksome Chine the rate of settlement was about 2 inches per second. In all the processes of transport by wind or water which are connected with the formation of waves or ripples of granular material the rate of subsidence is the dominant factor, and expresses, better perhaps than any other single quantity or dimension, the specific resistance of the material to transport. The power to transport in suspension is due, or mainly due, to upward swirls. If in a given current these have a velocity of 2 inches per second, sand which settles at that rate in still water would just be maintained in continuous suspension. In the case of shingle travelling in quantity (which it is more important to consider than the case of an isolated large stone being trundled over a comparatively smooth surface † of smaller stones) the effect of the upward swirl is probably of capital importance, and it is, I suppose, on account of its efficacy that the shingle can travel shorewards even when sand is travelling seawards; for the upward swirl made by the forward current of the waves in shallow water is much more powerful than that made by the slower return current of the wave. Hence the heavy shingle is jerked forward just after the passage of the crest of each advancing wave, but remains anchored during the return current until at last the slope of the beach tends to equalize matters. My second suggestion is that systematic observations, such as Dr. Owens has made so well in shallow streams, should now be undertaken with the aid of the diver's dress in deeper water.

In conclusion, I should like to draw attention to some definite measurements of rate of travel on a shingle beach which were taken by my friend Mr. Nelson Richardson (after consultation with me) on the Chesil beach.‡ Some of the half-bricks which he dumped on the beach between tide-marks travelled during twenty-eight hours of fine weather 574 yards, a speed which, if continued, would be sufficient to have carried them the whole length of the beach, *viz.* 18 miles, in seventy-two days. With regard to this question of the carrying power of currents

* *Geographical Journal*, August, 1901. "Sand-waves in Tidal Currents."

† See remarks in *Q.J.G.S.*, vol. 53 (1897), p. 244.

‡ "An Experiment on the Movements of a Load of Brickbats deposited on the Chesil Beach," *Proc. Dorset Field Club*, 22 (1902), pp. 128-138.

suddenly increasing when you pass from stream-line flow to eddying flow, of course the effect of waves is to impart something of the character of an eddying current, because they produce those sudden upward swirls which raise the material into suspension.

Dr. MILL also spoke.

Dr. EVANS: I should like to call the attention of the committee to the importance of the question which has been raised as to the existence and distribution of currents sufficient to carry shingle from place to place. Recently Prof. Cole and Mr. Crook, who have examined the blocks and pebbles found on the submerged continental shelf off the west coast of Ireland, have shown that the distribution of the different rock types indicates that the material has not, as a rule, been transported any considerable distance by currents, and that it furnishes valuable information as to the geology of the sea-floor. There are many other places at a considerable distance from the coast where banks of shingle occur beneath the sea. In the absence of powerful currents or of transport by ice, these would date back to a time when such localities were in the neighbourhood of the shore-line, and furnish evidence of the depression of the land relatively to the sea. At the same time, as in the area to the west of Ireland, they may in many cases lead to important conclusions as to the solid geology of the sea-bottom.

Captain TIZARD: I should like to say a word. I think it would add very much to the information that has been given if the slope of the bottom was stated in all these experiments. Whether a stone would be moved by a current on a perfectly flat surface in the same way as down an incline is doubtful. In all these experiments the stone has not been moved on a flat surface, but down an incline, for the water would only flow down that incline. With respect to the movement of the larger stones and not the smaller ones, I would suggest that this is due to the friction of the bottom making the water at the bottom move slower than that above. I think the flow might not move small pieces of shingle at the bottom, but might larger pieces above where the power of the water is greater. With respect to the disappearance of boulders, the boulders might disappear from quite another cause. Of the boulders washed off the Holderness coast, some might fall into a soft substance, and I know from practical experience on the east coast, directly an obstruction gets on the sands, the tide hollows out the sand around and the obstruction sinks down. This goes on on the Goodwin sands and in the estuary of the Thames; hence the saying these are quicksands. Of course they are in that way. However, I quite agree with the author's conclusions that it is not the current that erodes the coast; it is the wave-action.

Captain CREAK: Very much to the point has already been said, but I should like to make a remark or two. About three years ago Prof. Herdman, who is engaged in natural history inquiries, asked me a question with regard to the action of waves produced by a cyclone over a plateau of 12 fathoms of water, and whether substances at the bottom would be moved by the waves at that depth. I replied in the negative. I have since thought over the subject, and I remember being at anchor on the open coast of New Zealand during a severe cyclone, when the water broke in 7 fathoms and caused a violent disturbance of the materials at the bottom. You could see the sand moving in remarkable swirls, but I do not think the waves had any action beyond a short distance from those breakers. Hence I believe, if materials are moved at the bottom, it must be due to the current. Some time ago I was staying at Skegness, on the Wash, and I observed there that the beach was continually changing, and the calm water near the shore constantly full of fine *débris* in motion with the tide. Thus currents may carry such *débris* far and wide, but it must be the waves breaking upon a coast which are the cause of the motion of stones and coarse sand.

Mr. G. G. CHISHOLM : With regard to what Captain Creak says as to the power of the waves in moving matters at considerable depth, it may be not uninteresting to call attention to the fact that Sir William Matthews, on the occasion of his recent presidential address before the Institution of Civil Engineers, made some remark on that point. He says, "The depth to which wave-action extends is much greater than was formerly believed to be the case. With reference to the exceptional depths to which wave-disturbance extends, the late Sir James Douglass once mentioned at a meeting here that lobster creels, off the Land's End, lying in from 20 to 30 fathoms, had been found to be filled with sand and shingle on their withdrawal, subsequently to a heavy gale, some of the stones weighing as much as 1 lb., thus showing in that position sea-action had descended to the depth named. I may observe that off the coast of Peterhead and Fraserburgh, there have been similar experiences. Sir James Douglass, at the same meeting, also gave a remarkable instance of coarse sand having been found on the external gallery of the Bishop Rock Lighthouse off Scilly, after a gale, at a height of 120 feet, the depth of water in the vicinity of the rock being 25 fathoms, thereby showing that the sea-bed had been disturbed at that depth, this being the only source from which the sand could have been obtained." It seems to me that these observations have some relevance to the point raised by Mr. Lamplugh, and might explain how the submarine movement took place at Holderness. It might be accounted for by what Dr. Owens has called the interaction of waves and currents. The action of the waves might bring about such an upward swirl in the manner described by Dr. Vaughan Cornish, as to put heavy matter like boulders into such a position as to be dealt with by currents.

The PRESIDENT : I am afraid I must bring a most interesting discussion to an end by calling on Dr. Owens to reply.

Dr. OWENS : With reference to Dr. Strahan's and another gentleman's remarks, I want to make one point quite clear. I did not intend my paper to convey the impression that movement could not take place in deep water. I am aware that movement does take place, due, in my opinion, to the interaction of waves and currents, but the paper referred entirely to currents, and did not take into consideration the effect of waves. I think the second speaker who suggested the conclusion should be modified misunderstood me, because I did not come to the conclusion that movement did not take place, but rather that currents alone, in the absence of waves, had little effect. And I also wish to say that in my mind I limited wave-action to the continental shelf. I think outside that there is no question about the waves not touching bottom, and therefore outside the continental shelf, in deep water, I am of the opinion that the conclusion applies. Dr. Cornish's remarks have been extremely interesting, and I am very glad to see he has confirmed my observations as to the sand-movement. I may say that I have observed the peculiar sand-waves which he referred to, and, roughly speaking—I did not get an accurate measurement—I thought their formation began at about 3 feet per second. The small ordinary ripples were swept away, and suddenly a large wave, of about 3 feet from crest to crest and about 2 inches high, was suddenly formed; and it travelled up against the stream, as distinct from the small ripples, by the transference of sand from the front of one to the back of the other. With reference to the interaction of waves and currents, it appears to me that Dr. Cornish gives a clue to a great many difficulties—that is, that when the waves are rolling over a current you cannot expect that current to be flowing in stream-like motion, consequently we have a state of eddying suspension earlier than if there were no waves. I think the movement of material at Holderness and elsewhere must be looked at entirely from the point of view of the interaction of both waves and

currents. With reference to the suggestions which Dr. Cornish made as to further experiments, I am aware that there are many points which require to be settled. The rate of settlement in water I have worked out theoretically, that is, I found the current which, by an upward velocity, was required to suspend the particles, or the impact of which was equal to the weight of the particles in water. The results compare favourably with any observations I have been able to find. Then again, as to systematic observations in deep water, that I have not done; I have not all the necessary appliances. It is very difficult to see what takes place, and difficult to measure the current on the bottom in deep water; consequently, it is altogether a more difficult thing to do than the shallow-water observations. A point was referred to which I think I should make clear, that is the slope of the bottom. Now, I did not actually level the bottom, but I feel satisfied that the bottom was in all places, except perhaps one, practically level; also the inference which was drawn from the flow of water I think is incorrect—that is, that the water would not flow unless the bottom was on a slope. The flow of the water depends upon the surface slope of the water itself, and not upon the bed over which it is flowing. Captain Creak mentioned limiting the depth of wave-action to 7 fathoms. It is very difficult to say where wave-action ceases. I am disposed to think myself it is somewhere near the edge of the continental shelf, but where I do not know. It is very suspicious to see the continental shelf all strewn with *débris* from the land, and I should not wonder if wave-action takes place at 100 fathoms, and the edge of the shelf was its seaward limit.

The PRESIDENT: I am sure we shall pass a hearty vote of thanks to Dr. Owens for his paper, which has given rise to so interesting a discussion.

A NEW DISTANCE FINDER.*

By E. A. REEVES.

IN geographical and other survey work it is often of great importance to be able to obtain distances rapidly without actual measurement upon the ground, and without having first to set off a known distance as a base, which is necessary with many telemeters and rangefinders. The existing instruments for this purpose depending upon the angle subtended by a short rod, are either too liable to be put out of adjustment for rough exploring work owing to derangement of prisms and change of temperature, or necessitate the sending of an assistant with a rod to the point of which the distance is required. The Bar Subtense instrument, as used by the Survey of India, is of the latter class, and is excellent in its way, but the sending of a man with a rod is often most inconvenient, and naturally *limits its use to accessible positions*. What is wanted is an instrument of this character, strong and simple in construction, not liable to inaccuracies through the derangement of adjustments, and without the necessity of a separate rod, so that distances of inaccessible as well as accessible points can be quickly measured with sufficient accuracy for practical purposes; and I have designed the "Distance Finder" here shown to meet these requirements.

As will be seen from the figure, this instrument consists of a light rod of a certain fixed length, made so that it can be revolved vertically and horizontally upon a tripod, and carrying two telescopes, one at each end of the rod, and connected by a band of "invar." These telescopes can be revolved independently, each

* Research Department, February 21, 1908.

on its own axis, in a vertical plane, as well as rotated in collars in the line of their optical axis, to correct for collimation error.

The two telescopes are similar in general appearance, but while in the diaphragm of one there are only a fixed central vertical wire and a horizontal wire, to the other, in addition to these, is fitted a micrometer, by means of which a second vertical wire can be moved across the diaphragm. The rod is fitted with a clamp and tangent screw, and with the telescopes, can be taken bodily off the stand, reversed vertically, and replaced upside down, as well as revolved horizontally.

The system of taking observations for obtaining the distance of an object is so arranged that by repeating the measurement with the rod and telescope in different positions errors in vertical and horizontal parallelism, as well as in collimation, are eliminated, so that, should the adjustments be deranged, or the rod become slightly



REEVES'S DISTANCE FINDER.

flexed by any means, the errors are detected and made to balance each other, and the mean of the observations will give the correct distance. This is a most important feature in the instrument, and renders it suitable for use under somewhat rough conditions.

Upon the side of the rod will be found a scale of divisions and corresponding distances in feet, which, to ensure accuracy, has been constructed from known distances. The distance it is possible to measure with this instrument will, of course, depend principally upon the length of the rod, and the accuracy with which the observations are made, but it compares favourably with the Bar Subtense instrument now in use, while the method of repetition and elimination of errors considerably increases the possible accuracy of the results. The usual length of rods now made are $2\frac{1}{2}$ feet and 5 feet. The makers of this "Distance Finder" are Casella & Co., 11 to 15, Rochester Row, Victoria Street, S.W.

REVIEWS.

EUROPE.

THE SCANDINAVIAN FLORA.

'Die Entwicklungsgeschichte der Skandinavischen Flora.' Von Dr. Gunnar Andersson. *Maps and Illustrations*. Résultats scientifiques du Congrès international de Botanique. Wien, 1905. Pp. 45-47. Jena: G. Fischer. 1906.

Any discussion regarding the history of the Quarternary flora of the Scandinavian peninsula must take the Ice age as its starting-point. The chief problem before the investigator is a determination of the nature of the vegetation during the inter-glacial periods. The author compares some of the intra-morainal fossil-bearing deposits of Scandinavia and Denmark, and he comes to the conclusion that they do not correspond exactly to the inter-glacial deposits of the continent, the nature of which is well known. The chief part of the paper is made up of a very clear and interesting account of the five periods corresponding to five successive layers of fossil-bearing deposits. The gradual rise and, comparatively speaking, fall of the plant-types characteristic of the five periods is described, and the reader is left with a very vivid picture of the history of the Scandinavian flora. The Dryas flora of the first period was more or less arctic and alpine in character, and took possession of the land as it was vacated by the receding ice. This period was followed by that of the birch trees, which brought with them a large portion of the plants which are still to-day common in Scandinavia. Then followed the period of the pine, which was succeeded by the oak period. During this age, which was milder than even the climate of to-day, the oak went further north than it is found growing to-day. Finally, the spruce period set in, which has not really yet reached its complete development. The author discusses the influence of man on the vegetation of this district. He is also able to establish the existence of three periods in the aquatic vegetation. To the Dryas period corresponds that of the water-weed; the water-lilies are the characteristic aquatics during the birch and pine periods. *Trapa natans* was flourishing during the latter part of the pine, but mainly during the oak period, and is now almost extinct. Numerous photographs illustrate this very interesting and instructive article.

O. V. D.

ASIA.

TWO BOOKS ON CHINA.

'Anglo-Chinese Commerce and Diplomacy.' By A. J. Sargent, M.A. Oxon., Appointed Teacher of Foreign Trade in the University of London. Oxford: Clarendon Press. 1907.

'Railway Enterprise in China: an Account of its Origin and Development.' By P. H. Kent. London: Edmund Arnold. 1907.

Too much cannot be written about China by those who are in a position to add to our knowledge of the country and its people from actual observation, or who have taken the pains to acquire information on the subject and set it forth in a convenient and instructive manner. Mr. Sargent's book is an admirable example of the latter class. It is almost entirely based on first-hand authorities—treaties, books written by members of embassies to China, parliamentary papers, of which a list is given in the bibliography, British consular reports, and reports of the Imperial Maritime Customs. The author is gifted with the power of seeing both sides of a question, and writes with an obvious desire for strict impartiality, indicating fairly the Chinese as well as the British point of view in the unending series of difficulties that have obstructed the course of British trade with China, and beset the diplomacy to which that has given rise. He is also a skilled statistician, a

matter of peculiar importance in dealing with the complexities of Chinese trade returns. The volume is divided into eleven chapters, most of which are devoted to the historical statement of diplomatic relations between Great Britain and China, four chapters being intercalated on the course of trade at different periods. It is thus mainly of historical interest, but no doubt there will be more geographical interest in the sequel to it, of which Mr. Sargent holds out the hope, designed to contain "the analysis and explanation of the commercial condition of the present," and thus to fulfil "the ultimate aim of the history." One notable fact of geographical interest may be mentioned as standing out from the text, namely, the long-continued and wide-reaching importance in British trade of raw materials of British origin and manufactures of these. In speaking of British trade with China in the days of the East India Company, Mr. Sargent mentions that the "goods exported consisted almost exclusively of woollens, and a little lead, iron, and tin," British articles of export dating back in some cases to the time of the Romans, and the most important of them one that began to displace the earlier export of raw wool about the fifteenth century. Even in 1833, the last year of the company's exclusive privilege, woollens constituted more than ninety per cent. of the British exports to China.

Mr. Sargent's general conclusion on the present situation is worth quoting—

"At present she [China] is in tutelage, with her financial and economic policy laid down in treaties forced on her by Foreign Powers. . . . The Chinese may be coerced into restraining their resentment for a time; the history of their relations with European Powers proves amply that they neither change nor forget. Once they obtain sufficient material force, they are likely to assert in no uncertain fashion the claim to that right enjoyed even by minor Western nations, the right to determine for themselves the conditions of intercourse with foreigners."

As this work seems certain to meet with a steady demand, which will soon necessitate a new edition, attention may be drawn to a few improvements that may be made with a view to that. Occasionally the author assumes more knowledge on the part of the reader than one is entitled to expect from one who comes new to the subject. On p. 10 a reference made to the critics of the East India Company will cause many a reader to ask what was the nature of their criticisms, a question on which he is not clearly enlightened till he comes to p. 49. The explanations on pp. 8 and 41 as to the private trader are not enough to enable the reader to understand the conditions under which tea, a strict monopoly of the East India Company to the end of its days as a trading company, was sold, was imported into Great Britain by private traders, as appears from p. 53 and elsewhere. One who reads on p. 115 of "the rebellion" in China, and is unacquainted with the history of China in the fifties and sixties of last century, will ask, "What rebellion?" Lastly, on p. 2 a reference is made to "the newly formed East India Company," in such a manner as will induce the reader to believe that the company was already in existence in 1596.

The full title of Mr. Kent's book sufficiently indicates its scope. The preface is dated August 28, 1907, and down to that time the text appears to give a full account of the position of the railway enterprise in China. Five maps furnish an important aid in enabling the reader to grasp the present situation, one of them being a general map, distinguishing by colours and signs the nationality of the capital employed or to be employed in the construction of railways opened, constructing, and projected. When works are in active progress while maps are in preparation, it is not to be wondered at that the maps should not be quite up to the date of the text, and as the maps are most likely to be consulted first, and in some cases perhaps solely, it may be well to point out that the text mentions (p. 72) that

a section of 33 miles (more than one-fifth) of the Peking-Kalgan railway was opened on September 30, 1906; that the railhead of the Chengtingfu-Taiyuanfu railway is now beyond Pingtingchow (p. 170), and that the Kaifengfu-Honanfu railway was opened to public traffic in April, 1907, as far as Chenchow, the junction with the Peking-Homkow railway, although all these railways are shown on the map (or maps) as entirely under construction. The maps are all merely outline maps, but the text contains indications as to the geography of the routes followed by the different railways, and summary considerations of the commercial significance of the lines constructed or planned. A valuable feature of the book is the appendix of 100 pages, containing the full text of various agreements entered into with reference to the construction of various railways. The index is, unfortunately, not quite adequate, and the English is not unexceptionable ("Stress was lain on," p. 29; "In normal times this river is a narrow sandy valley," p. 37).

G. G. C.

AFRICA.

THE WILD FAUNA OF AFRICA.

'In Wildest Africa.' By C. G. Schillings. Translated [from the German] by Frederic Whyte. Two vols. London: Hutchinson & Co. 1907. Price 24s. net.

Mr. Schillings achieved reputation 'With Flashlight and Rifle in Equatorial East Africa,' in consequence of the extraordinary merit of the photographs it contained, the illustrations revealing as no photographs had ever done before the nature and manner of life of the wild animals depicted. His new work contains over 300 photographic studies of the fauna of tropical Africa, reproduced from the original negatives without retouching of any kind. Some of the photographs were taken at night, and many in circumstances requiring all the skill and nerve of an intrepid hunter. The result is a series of absolutely trustworthy records of wild life at a given hour in bush, veldt, forest, or stream. Their value to the naturalist can hardly be overestimated, and in a couple of decades, or even less time, may be in many instances the only evidence obtainable as to the game in Central Africa at the close of the nineteenth century. The larger fauna of South Africa has been nearly exterminated in little more than fifty years. The process will be repeated, at an accelerated rate, in the regions further north unless Mr. Schillings' pleadings for preventative measures be heeded. Certain large game reserves have been created—the British reserves alone are five times the size of Scotland—but hitherto international action has been weak, and the "sportsman" of the baser kind strong. The author himself is of opinion that there is only one chance of the beautiful wild life of Africa being permanently preserved, "and that lies in the hunters themselves consenting to protect and spare it." His view that the hunter should also undertake the part of preserver, the author further enforces in an interpolated chapter on "Sport and Nature in Germany."

Photographs of the native fauna "at home" naturally reveal a good deal of the flora of their habitat. Thus, 'In Wildest Africa' contains much information concerning the distribution of the flora as well as the fauna of the equatorial regions. Mr. Schillings, in fact, heads his first chapter "The Spell of the Elelescho," Elelescho being the Masai name for *Tarchonatus camphoratus*, L., the characteristic bush of considerable areas of British East Africa. The author's style is poetical and impressionist, perhaps a little fatiguing, but often his vivid imagery gives exactly the desired impression, as when he compares the flamingoes lining the shores of a lake to "a garland of living lake-roses." The burden of the whole book is a passionate protest against the destruction of wild life, whether "noxious" or not—a protest at the same time reasoned and reasonable. There are two statements, incidentally made, to which exception may be taken. On p. 19,

vol. 1, the author refers to Dr. Kandt as "the discoverer of the source of the Nile"—a misleading assertion all the more regrettable as a little later (on p. 66) J. H. Speke is described as "one of the discoverers of the Victoria Nyanza." There is no need to belittle Speke in order to exalt Dr. Kandt, nor any justification for misdescribing Speke's achievements.

F. R. C.

AMERICA.

THE AMERICAN INDIANS.

'Die Schifffahrt der Indianer.' By Dr. Georg Friederici. Pp vi. and 130. Stuttgart: Strecker & Schröder. 1907.

One of the strongest arguments advanced by the advocates of the independent evolution of American culture since the Stone Ages is the primitive condition of navigation at the time of the discovery. It was naturally urged that, if the natives possessed no seaworthy vessels in the late pre-Columbian period, they never possessed them; and without them the highly specialized civilized peoples of the eastern hemisphere could not have reached the New World, even by the one land route then and still occupied by Siberian savages.

Now the author of this learned essay surveys the whole field from Alaska to Fuegia, and finds nothing anywhere, before the advent of the whites, except the frail Eskimo cayaks and umiaks, the bull-boats of the plains Indians, the various types of dug-outs and of birch-bark and other canoes ranging over the whole continent, the Peruvian balsas (rafts) propelled by shreds of sails, and such-like crazy craft. There were no decks, no masts, no rudders, no oars, nothing but paddles, or here and there the scull. Many were propelled by long poles in shallow waters, while the better-constructed Araucanian *dalca*, the large Abenaki boat, and the pirogue of the Caribs, best equipped of all the native craft, never ventured on the high seas out of sight of land, although they might be 50 or 60 yards long and carry crews of from eighty to a hundred men.

Dr. Friederici's statements are all the more worthy of credence, since they are not only drawn from the best available sources, but are also absolutely unbiassed. He has no theory to serve, indulges in no speculations, and is quite indifferent to the consequences that may be drawn from the results of his researches in this hitherto neglected field. There is no index, and a large body of notes prepared for this issue unfortunately disappeared before going to press. But some compensation is made by a very full list of authorities, occupying no less than twenty pages. It should be added that this volume forms one of the series of the "Studien und Forschungen zur Menschen- und Völkerkunde" now being issued under the editorship of Dr. Georg Boechan, of Stettin.

A. H. K.

INDIAN ROCK-DRAWINGS.

'Südamerikanische Felszeichnungen.' By Dr. Theodor Koch-Grünberg. With 29 Plates and 86 Inset Illustrations. Berlin: E. Wasmuth. 1907.

Here we have at last a complete monograph on the puzzling petroglyphs which are distributed in large numbers over a great part of South America, but occur most frequently in the region between the Amazons and the Caribbean sea. The work, which is in a measure complementary to the author's 'Anfänge der Kunst im Urwald' (1906), is conveniently divided into three distinct sections, the first comprising an exhaustive survey of the whole field, with copious references to the collections and observations of previous explorers; the second giving a detailed account of all the carvings which were studied and partly copied by the author himself during the years 1903-1906, on the upper Rio Negro and its affluents and

in the Yapura basin; the third containing a critical examination of the various views hitherto advanced on the origin, antiquity, and significance of the so-called "inscriptions," with the author's final conclusions on the subject.

It should be added that the twenty-nine plates comprise carefully prepared reproductions of his own collections, on the study of which his conclusions are chiefly based. He refuses to look on these rude objects "through learned spectacles," or to read into them lofty notions quite beyond the mental capacity of the present natives, to whom and to their still more primitive ancestors the carvings are unhesitatingly ascribed. They are not historical documents, or even records of passing events; they cannot be regarded as in any sense pictorial writings, nor do they possess much, if any, religious significance, and Orsi di Monbello's fantastic interpretations are dismissed with contempt. If you like to indulge in such extravagant ravings, you may draw anything, however absurd, from the rock carvings, the style of which is quite primitive and artless, "the same elementary forms recurring again and again, not only in the upper Rio Negro and surrounding districts, but throughout the whole of South America." In fact, the conclusion is the same as that arrived at by Mr. Cyrus Thomas regarding the North American mound-buildings. None of these things are beyond the power of the present Amerindians, and of any earlier races of higher capacity nothing is known.

A. H. K.

THE QUICHUA LANGUAGE.

'Vocabularies of the General Language of the Incas of Peru, or Runa Simi (called Quichua by the Spanish Grammarians).' By Sir Clements Markham, K.C.B.
London: Ballantyne & Co., Ltd. 1907.

In his introduction to this work, the author says, "The general language of the Incas of Peru is spoken in the Andean regions of South America over a vast area from Quito to Tucuman and Catamarca, in the Argentine Republic. It was the wisdom of the Incas to endeavour to establish one language throughout their dominions." He gives an interesting account of the spread of this court language of Cuzco, and of the works regarding it which various authors have published since 1560. Garcilaso de la Vega, Inca, states that it was the general tongue, and that his ancestors decreed that all men should learn it, and that natives of Cuzco were sent to teach it to all new vassals.

This propagation of the court language was not very difficult, for it is notable that any South American Indian learns the language of another with extreme facility. Some scholars contest the claim of Sir Clements that there was but one *general language*, and that there was another, now spoken by the Aymarás of the Titicaca basin, who number about half a million people in Bolivia and Perú. "This region," says Sir Clements, "was originally inhabited by tribes called Collas, Lupacas, Pacasas, Pacajes, and Urus," and "there is not a single early writer who used the word Aymará in connection with these tribes." He characterizes it as a "blunder" to call the people of the Collao and their language by that name, and that "the word must have been unknown with reference to the people of the basin of Lake Titicaca at the time of the conquest."

At La Paz, the centre of the Aymará region, the members of the "Aymará Academy," devoted to the study of the people and their language, take exception to such a conclusion. They state that Señor Loayza, Archbishop of Lima, during the councils held there (1552-1567), suggested that "special attention should be paid to the two general languages of Perú—the Quichua, or tongue of the Inca, and the Aymará."

The first book issued from the printing press of Lima was a 'Doctrina Cristiana y Catecismo para instruccion de Indios' under authority of the Provincial Council.

Its title-page reads: "Translated in the two general languages of this kingdom, Quichua and Aymará, Año de MDLXXXIII. Año," 4^o, xiv. + 84 pp.

At La Paz, the Aymará scholars refer to Padre Bartolico's work, also mentioned by Sir Clements Markham, and quote from the introduction written by the Padre at Juli 1596: "There are many nations of Aymará Indians, such as the Canchis, Caunas, Collas, Collagues, Lupacas, Pacacas, Carancas, Charcas, and others; and as they have different names, so they speak different tongues. There is taught in this book the Lupaca language . . . , which among all the Aymará tongues holds the first place. The Pacacas and Lupacas are in the midst of all the Aymaras."

The contention between Sir Clements Markham and his critics on the Andes, among whom is the cabinet minister, his Excellency M. V. Ballivian, the erudite President of the Geographical Society of La Paz, is extremely interesting, and the linguistic world, as well as the student of the history of the Inca empire, owe a debt of gratitude to Sir Clements for originating the controversy. He must be a profound Quichua and Aymará scholar who dare enter the arena, and must belong to the *retiaris* if he hope to entangle his adversary.

But Sir Clements has ample field for his 'Runa Simi' in a belt of the Andes 2500 miles in extent, and eastward, in several places, to the base of the cordillera. Even on the Javary river, boundary between Brazil and Perú, the tribes use Quichua to-day as a general tongue; but its spread down the eastern slopes of the Andes is due more to the Jesuit, Franciscan, and other missionaries than to the Incas themselves. The Portuguese missionaries carried Tupi as a *lingua geral* up the Amazon to the boundary-line of the Spanish colonial possessions, where they met the Spanish Padres who had descended the Andes armed for their spiritual labours with the Quichua language, which, as a preliminary, they taught the various fragments of tribes from which they formed their missions, for they could find no one language among their neophytes which so well served their purpose. Hence at the colleges of Quito and Ocopa it was incumbent on every friar to learn Quichua before he departed for the scene of his labours among the savages whose territory once bordered the Inca empire.

All of the Quichua-speaking regions are now awakening to intense activity under the lash of modern progress. Perú and Bolivia especially are rapidly coming to the front. The commerce and internal development of the west coast of South America, including Ecuador, cannot be urged to their best possibilities without their representatives being equipped with some knowledge of the Quichua language, and Sir Clements Markham's timely little compendium of it offers an excellent medium for acquiring, not only an outline of its grammar, but an ample vocabulary for all essential purposes.

G. E. CHUBOK.

AUSTRALASIA AND PACIFIC ISLANDS.

VEGETATION OF WESTERN AUSTRALIA.

'Die Pflanzenwelt von West-Australien südlich des Wendekreises. Mit einer Einleitung über die Pflanzenwelt Gesamt-Australiens in Grundzügen.' Von Dr J. Diels. *Maps and Illustrations.* Leipzig: Wilhelm Engelmann. 1906.

Another very valuable addition to our rapidly increasing knowledge of the world's vegetation has been made by the appearance of a monograph by Dr. L. Diels on the plant-world of that part of Western Australia which lies to the south of the tropic. The most interesting portion almost of the whole book is the introduction. This places before the reader a concise summary of the characteristic features of the vegetation of the whole Australian continent. The vegetation of the great central plateau is tropophil or xerophil, exhibiting all possible modifications, till it becomes of the nature of a desert formation. Along the northern and

eastern coast of the continent there is a broad strip of more luxuriant plant-growth, with even a true rain-forest in one part. To the north-west and in the south along the great Australian bight, the steppe-like character of the plateau-vegetation reaches the coast. The south-western corner has only a narrow strip of hygrophil vegetation. Towards the end of the book Dr. Diels discusses the relation of the flora of extra-tropical Western Australia to other parts of Australia, and to other parts of the world. This flora is typically Australian, and thus shows distinct affinities with the eastern and northern districts. It exhibits, however, no real connection with any other part of the Earth. On the whole, also, there are very great differences between the vegetation of the Cape and that of Western Australia, although affinities have always been made much of. But the difference in species and types of vegetation is really more marked than the similarity. What there is of the latter may be explained by assuming a far-back common origin from an ancient southern-hemisphere flora, or by development along analogous lines. The working out of the history and development of these two floral districts is one of the important problems of plant-geography. O. V. D.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

TWO TEXT-BOOKS OF SEISMOLOGY.

- (1) 'Earthquakes: an introduction to Seismic Geology.' By William Herbert Hobbs. New York: D. Appleton & Co. 1907. P. xxxi. and 336, 24 *Plates*, 309 *Illustrations in Text*. Price \$2 net.
- (2) 'La Science Séismologique. Les tremblements de Terre,' avec une Préface par M. Ed. Suess. Par Comte de Montessus de Ballore. Paris: Armand Colin. 1907. Pp. viii. and 579, 63 *Plates*, 540 *Illustrations in Text*. Price 16 fr.

Ne auctor ultra crepidam is a maxim which would lead to stagnation in science if carried to an extreme, but the cobbler who takes up another trade should learn it thoroughly before he begins to teach, and this Prof. Hobbs has not done. A geologist of reputation, he has developed a theory of earthquake origin which we accept in part, though not entirely; but as regards the science of seismology as a whole, his acquaintance with the work which has been done is imperfect, and as a guide his book is frequently misleading by its omissions. The title would lead us to expect a full treatment of the geographical aspects of earthquakes, but even here he passes by much of the work which has been done by others in establishing the fact that earthquake origins are much more extended than was at one time supposed, and he attributes the discovery of the principle of steepest slopes to de Montessus instead of to Prof. Milne. This principle, that the regions of great seismic and volcanic activity are those in which the average surface slope is highest and steepest, is one which, like the continent of America, could not escape discovery; its truth is more important, from a scientific point of view, than the name of the man who first gave expression to it, but if this is mentioned at all, it is well to be accurate.

The Comte de Montessus de Ballore is a seismologist of established reputation, whose work has lain in the domain of statistical and geographical seismology. In writing a general treatise on the science, he has had to deal with subjects which he beyond the province of his labours previous to his acceptance of the post of director of the Seismological Service of the Republic of Chile, but, having read nearly everything that has been written, and remembered nearly everything he has read, writing, moreover, with the lucidity and precision of a Frenchman, he has produced a remarkably complete text-book of seismology. The only section with which we find serious fault is that dealing with instruments, where the want of experience in their use, or in the interpretation of their records, has led him

into error in more than one instance. His explanation of the principle of the duplex pendulum is not that offered by the inventor, nor is it the correct one, and the illustration on p. 291 of the principle of the light and the heavy horizontal pendulum is curiously in error. The principle of the horizontal pendulum is the same whatever the weight, but it may be applied in two different systems of mechanical construction. In the one a boom is pivoted to a support, and maintained in a horizontal position by a wire or thread attached to some point along its length. This is the system adopted in what we may call the Japanese type of horizontal pendulum, since it was elaborated in that country, and is the system depicted as the principle of the heavy pendulum; but it is also the system adopted in the Milne instrument, which is, in proportion to its dimensions, the lightest in use. The other system of construction utilizes a rigid bracket-like framework, which is pivoted on two knife-edges. This system may be illustrated by the garden gate, and is the one figured as the principle of the light horizontal pendulum; it is, however, adopted in the heavy horizontal pendula used in Italy, and is the only system mechanically admissible where very heavy weights are concerned; it is also utilized in the v. Rebeur Paschwitz instrument, which is classed as a light pendulum, though its lightness is solely the result of its small dimensions, and in proportion to these it should be classed as a heavy pendulum. The praise of the Wiechert instrument goes too far, and some of the claims made for it cannot be substantiated; it is not astatic in reality, but only in name, nor does the damping of the pendular oscillation enable it to record the actual movement of the ground. In saying this we intend no disparage; the instrument is an admirable one, and marks the introduction of what may be called a new principle, at any rate, a new method of applying an old principle, in the construction of seismographs, but this does not make all other patterns obsolete, or do away with their utility. The astronomer does not discard his transit instrument because it will not serve the purpose of an equatorial telescope, and so more than one type of instrument will continue to be required in seismology, and the free-swinging pendulum, whether vertical or horizontal, will still continue to be used and to be useful.

Apart from this chapter, the book deserves praise as an account of the present state of our knowledge of earthquakes, and we may especially commend the inclusion of two chapters dealing with the methods of construction to be avoided or adopted in countries subject to earthquakes. This is a practical application of the principles of seismology which is generally neglected in treatises of the science.

R. D. O.

GENERAL.

THE GEOLOGICAL SOCIETY OF LONDON.

'The History of the Geological Society of London.' By H. B. Woodward. London: The Geological Society. 1907. 1p. xx., 336. With 23 Plates of Portraits, and 5 Plates of Medals. Price 7s. 6d. (to Fellows, 6s.).

The unique position of London has given its scientific societies the opportunities for exceptionally useful service; and probably no society has had a more profound influence on the science with which it is concerned than the Geological Society. It was established on November 13, 1807, when eleven men met at the Freemasons' Tavern, and arranged to join periodically in a dinner at five o'clock, to be followed by a meeting for geological conference and discussion. The combined social and scientific aims of the young society led to an almost immediate split in its ranks. Sir Humphrey Davy and Sir Joseph Banks held that the society was only intended to be a "little geological dining club," which was not to encroach on the sphere of the Royal Society by the publication of a new scientific serial. According to those

of the founders who were primarily geologists, the dinner was of secondary importance to the serious scientific work of the society, and they intended its work to be very serious. Geology was then disturbed by a spirit of reckless speculation, which it had inherited from its ancestor Cosmogony. It was the aim of the founders of the Geological Society to rescue geology from unscientific methods, and to establish it on a firm basis of accurately observed facts. It was the ideal of the society to raise the status of geology "by toil, not by talk"—still less by dinners. The proposed federation of the society to the Royal Society was rejected, and Davy and Banks resigned their membership. Dinner as part of the official business of the society was soon abandoned, while the attendance at the meetings increased, and the papers and discussions grew in interest and importance. The researches of the members of the society on both British and foreign geology were rewarded by a rich harvest of valuable materials, and their publication on a worthy scale was rendered possible by the generosity of some of the members; and the early Transactions of the Geological Society were issued with a wealth of illustration that helped to raise the standard of scientific serial publication.

The society has been eminently successful in its mission. It has raised the status of geology, promoted the use of detailed field work, prepared the way for the establishment of the Geological Survey, and guided and inspired most of the best work in British geology. It published a geological map of England and Wales, which long remained the standard. Considering that the materials were collected by a small number of private surveyors, at a time when travel was difficult, slow, and expensive, and when the available topographical maps were very imperfect, the map is a monument to the devotion and skill of its authors. The society has been helped towards success by its strict attention to its work. It has been careful to avoid trespassing on other sciences, and declined to allow authors to transgress its boundary between geology and geography. The one occasion on which the writer had to abridge a paper submitted to the society was the omission of a few paragraphs which were regarded as physical geography rather than geology.

The society has gained world-wide scientific reputation; but as its meetings and publications have been confined to technical geology, it has made no wide appeal to popular interest. It has accordingly been the more easily able to maintain a high standard of scientific excellence. It has, however, always included among its Fellows men of leisure and wealth, and it has quietly accumulated a moderate capital and been able to afford the publication of its costly maps and Transactions. It has also collected what is perhaps the best existing geological library, and its 'Annual List of Additions to Geological Literature' is an indispensable instrument of geological research.

The story of the society's work has now been well and concisely told in a volume prepared for the recent centenary of the society by Mr. H. B. Woodward. He gives a full sketch of the foundation of the society, and briefly summarizes its later history and the chief branches of its work, and calls attention to some of the most famous discussions and contributions to science published in its Transactions and Journals. The narrative is enlivened by many racy personal anecdotes about the leaders of the society. The volume also contains a valuable collection of historical data, which will make it a work of permanent value in reference to the history of British geology. The work is illustrated with an excellent series of photographs from Buckland to its present President, Sir Archibald Geikie.

So many of the leading members of the Geological Society have also been connected with the Royal Geographical Society that Mr. Woodward's valuable monograph is a useful addition to the history of British geography.

J. W. G.

EARLY TRAVELS.

'Ibn Gubayr (Ibn Giobeir), *Viaggio in Ispagna, Sicilia, Siria . . . Mesopotamia, Arabia, Egitto.*' Prima traduzione, fatta sull' originale Arabo de Celestino Schiaparelli. Rome. 1906: Pp. xxvii., 412.

'The Travels of Ibn Jubayr,' edited . . . by William Wright. Second edition, revised by M. J. de Goeje. Leyden: Brill. 1907.

The Arabic text of Ibn Jubayr's travels was ably edited by W. Wright, with the aid of Prof. Dozy (Leyden, 1852); his account of Sicily was edited and translated, with most valuable notes, by M. Amari (Paris, 1846); his description of Syria and Egypt is in great part reproduced, the Arabic text being here also accompanied with a French version, in the '*Recueil des Historiens des Croisades, Historiens Orientaux*,' vol. 3 (Paris, 1884); and smaller sections have been dealt with in other works, such as E. Wiedemann's "*Beiträge zur Geschichte der Naturwissenschaften*" (in *Sitzungsb. d. phys.-med. Sozietät in Erlangen*, 1905); but Schiaparelli's version of the complete voyages of this great Spanish Moslem renders a great service to all scholars and historians, especially to those unacquainted or but moderately acquainted with Ibn Jubayr's mother-tongue. A valuable introduction (pp. vii.-xxii.) is followed by a useful summary of the route of our traveller, who, starting from Granada on February 4, 1183, returned to Granada on April 25, 1185. The translation itself, occupying 348 pages, is illustrated by serviceable notes, all too brief (pp. 351-68); good indexes of persons and places conclude the work. Among the most noteworthy sections of this *Viaggio* are (1) those which treat of Moslem Spain, the islands of the Greek archipelago, Crete, Sicily, Sardinia, and the Balearics (pp. 3-8, 310-348); (2) the Mesopotamian sections, especially the description of Baghdad (pp. 198-237, etc.); and (3) the Meccan and Damascene (pp. 53-150, etc., 251-293). Ibn Jubayr was endowed with exceptional qualifications as an observer and historian, and no serious student of the twelfth century can safely neglect him. It is regrettable that no map accompanies this issue.

In 1907 the Trustees of the *E. J. W. Gibb Memorial* re-issued Wright's text, revised by Prof. de Goeje, with Wright's original preface and notes, and some additions by the reviser. "But a comparison of my edition with the former" (Wright's original) "will show," says de Goeje, "that I had very little to change." It is interesting to know that Robertson Smith intended at one time to have undertaken this revision now carried through by de Goeje. C. R. B.

TEXT-BOOKS.

'A Scientific Geography.' By Ellis W. Heaton, B.Sc., F.G.S. London: Ralph Holland & Co. 1906. Book II. The British Isles. Book IV. North America. Book V. Africa. *Maps and Diagrams.* Price 1s. 6d. net each.

'Mathematical Geography.' By Willis E. Johnson, Ph.D. Pp. 322. New York: American Book Co. Price \$1.00.

'A Rational Geography.' In three parts. Part I (195 pp.) Climate; the British Isles; Europe. By Ernest Young, B.Sc. London: George Philip & Son. 1907. Price 1s. 6d. each.

Mr. Heaton's preface states that his books are for students who intend taking the subject for Matriculation, Preliminary Certificate, or Certificate Examinations. Each consists of Part I., dealing with general considerations; and Part II., sections "each giving all the materials required for a sketch-map such as examiners ask for." The aim of the author is fairly well fulfilled. But, apart from the geological treatment in Parts I. of each, which is in the main good and commendable, the humanistic geographical concepts are wanting, and hence Parts II. have little to recommend them from that point of view. The collection of facts will go far

towards enabling a student to meet the requirements of the above examinations. The plan of the books has produced a sound analytical treatment, with few mistakes of selection, and not many serious omissions. The type of treatment is naturally much on the same level for each volume. On the whole an advance is shown on the type of text-book generally in use, especially for the Preliminary Certificate Examination. Each volume has a glossary of geological terms, several diagram-maps, generally clear, and a set of typical exercises for the student to work out. Too many general and descriptive statements for which the teacher would have to find the details and illustrations detract from the "scientific" nature of the books.

Mr. Johnson's book is to be commended, being one of the few books which treat consistently of one aspect of geography. It is compiled from many sources to which the teachers can seldom, if ever, find opportunity to go. The first portion deals with the general aspects of this side of geography simply, and later chapters take up and expand or explain previous passages. The book is designed for secondary schools and for teachers' preparation, and for the latter it is a most useful compendium. The style is clear throughout, and the examples and applications are practical. There is a good chapter on Projections, appendices on Gravity, Motions of the Earth's Axis, Mathematical Treatment of Tides, the Zodiac, Practical Work in Mathematical Geography, formulæ and tables, and a glossary and index. These all supplement the fourteen chapters of the text. The publishers claim that it is a pioneer work. It is doubtful if that is entirely true in the strictest sense, but that does not detract from its value as a collection from many sources.

Mr. Young's books are designed to meet the requirements of the Board of Education's syllabus for secondary schools. In the first section an attempt has been made to place the psychological before the logical order of the subject. This section is brightly written, though the style is severely "heuristic," and might tax the patience of many pupils. In the later sections the severely logical arrangement militates against any regional treatment, and in places becomes a summary and little more, while a considerable amount of descriptive padding finds its way in, and serves to confuse the main issue. The whole planning, however, of the three years' work should be considered before passing too strong an opinion on the preliminary volume. There are several more expensive text-books which do not suit general requirements as well as this.

The consideration of these text-books leads one more than ever to the conclusion that, though a certain course may be planned for a term's or a year's work in geography, it is necessary to make provision for parallel courses in general aspects of the subject, such as Mathematical Geography, Climate, Morphology, etc., and especially are these the province of *practical* work. It is suggested, by the use of the term "parallel," that it is advisable to keep them distinct. The above-mentioned 'Rational Geography' seems to be arranged somewhat on these lines, and the 'Mathematical Geography' might well be used as the basis of a course of this kind.

F. G. A.

SHORT NOTICES.

Asia.—'Plagues and Pleasures of Life in Bengal,' by Lieut.-Colonel D. D. Cunningham (London: Murray. 1907. Pp. xi., 385. *Illustrations*. 12s. net), is divided into two parts, the first dealing with certain insects and other creatures of common occurrence in gardens and houses in Bengal; and the second (a more attractive section to the general reader) with "the seasons in a Bengal garden."

Africa.—'Cairo, Jerusalem, and Damascus: Three Chief Cities of the Egyptian Sultans.' By D. S. Margoliouth. (London: Chatto & Windus. 1907. Pp. xvi., 301. *Illustrations*. 20s. net.) Dr. Margoliouth, with some modesty, speaks of the text of this work as "the letterpress to accompany Mr. Walter Tyrwhitt's

drawings," but it will easily be recognized that the text stands on a far different level from that which so often fills out picture-books. The three-colour blocks which form the majority of the illustrations are also above the average of results achieved by this process, especially where the tendency to crudeness of colour is overcome.

'The Guide to South Africa.' Edited by A. S. Brown and G. G. Brown, for the Union Castle Steamship Co. (15th edition. London: Sampson Low. 1907-8. Pp. lvi., 478. *Maps*. 2s. 6d.) The present edition maintains its standard of value to "tourists, sportsmen, invalids, and settlers." Among Messrs. Philip's maps which it contains, those of scientific import, such as orographical, geological, and climatological, though inclined to roughness, are an unusual and laudable feature in such a book. When it is stated that Part I. of the text, dealing with the country from physical, economic, and historical aspects, covers 278 pages (Part II. being devoted to routes), it will be understood that in conception this guide is something more than merely a traveller's handbook.

'The Boa Estrada Plantations, S. Thomé.' By H. J. Monteiro de Mendonça. Translated by J. A. Wyllie. (Edinburgh: Oliphant, Anderson, & Ferrier. 1907. Pp. 63. *Illustrations*.) This is a study, with statistics and numerous excellent plates, of the methods and conditions of life on one of the most important estates in the Portuguese island of St. Thomas. Its object is to provide an example in colonial methods, such, it has been asserted, as are yet to seek in some parts of the Portuguese empire. The medical and general treatment of native labourers is the most prominent subject of the work.

America.—'Dr. John McLoughlin, the Father of Oregon.' By Frederick V. Holman. (Cleveland: Arthur N. Clark Co. 1907. Pp. 301. *Illustrations*. 12s. 6d.) This is a simple and interesting record of the career of the first pioneer of Oregon, a Canadian born (1744), who represented the Hudson's Bay Company in the far west, became an American citizen, and died in 1857, a victim of intrigues against the reward which his work should have brought him.

'Wirtschaftsgeographie der Vereinigten Staaten.' (Angewandte Geographie. III. Serie, 2. Heft.) By Prof. Dr. A. Oppel. (Halle: Gebauer-Schwetschke Druckerei. 1907. Pp. 160. *Diagrams*. 3.50m.) This is an encyclopædic study of the United States, especially from the economical standpoint, in a small compass. Considered as an educational work, it receives, to our ideas, a somewhat forbidding aspect from the extensive use of statistics.

'With the Border Ruffians: Memories of the Far West, 1852-1868.' By R. H. Williams. Edited by E. W. Williams. (London: Murray. 1907. Pp. xviii., 478. *Illustrations*. 12s. net.) This is an interesting narrative of a life of adventure in Western Virginia, Kansas, and Texas. It gives striking pictures of the West in these "early" times.

THE MONTHLY RECORD.

THE SOCIETY.

Royal Medals and Other Awards for 1908.—With the approval of His Majesty the King as Patron, the two royal medals for the current year have been awarded—the Founder's Medal to Lieut. Boyd Alexander, and the Patron's Medal to H.S.H. the Prince of Monaco. The story of Lieut. Boyd Alexander's three years' journey across Africa, the cost of which was borne entirely by himself and his brother officers who died during the expedition, is well known to the Fellows from Lieut. Alexander's letters in the *Journal*, and from the paper which he read

before the Society last session. Recently the results have been embodied in his work 'From the Niger to the Nile.' The Prince of Monaco has pursued the study of oceanography for many years, first on the sailing yacht *Hirondelle*, then from 1891 to 1898 on the schooner *Princesse Alice*, and latterly on the finely appointed steam-yacht of the same name, which he designed and equipped as an oceanographical laboratory. In recent years he has explored in successive seasons the coasts of Spitsbergen and the adjacent seas, and has published a remarkable and most valuable chart of the oceans, on which all deep-sea soundings are entered and isobaths drawn with greater detail than has been attempted elsewhere. Of the other awards, Lieut.-Colonel Delmé-Radcliffe receives the Murchison Grant for his survey work as Resident in the Nile Province of the Uganda Protectorate, and as chief of the British section of the Anglo-German Commission for the survey of the frontier between the Victoria Nyanza and Ruwenzori, an account of which he submitted to the Society in 1905; Dr. T. G. Longstaff, the Gill Memorial, for his explorations, carried out at his own expense, in the Himalayas, including the ascent of Mount Trisul as recently described by Dr. Longstaff at an evening meeting of the Society; and Rai Sahib Ram Singh, the Cuthbert Peek Grant, for his survey work during the past ten years in Tibet and Chinese Turkestan under Captain Deasy, Dr. Stein, Captain Rawling, and Major Ryder. As shown by Dr. Stein's letters to the *Journal*, Ram Singh has been for the past two years with Dr. Stein on the latter's second expedition to Chinese Turkestan.

Memorial to the late Sir Leopold M'Clintock.—The Royal Society, the Royal Geographical Society, and Trinity House have undertaken the expense of a memorial to the late Sir Leopold M'Clintock in Westminster Abbey, with the consent of the Dean and Chapter. The memorial will consist of an alabaster slab, to be placed underneath the monument to Sir John Franklin, whose fate was definitely ascertained by Sir Leopold during his celebrated expedition in the *Fox*. The inscription will be as follows:—

"HERE ALSO IS COMMEMORATED
ADMIRAL SIR LEOPOLD M'CLINTOCK
1819-1907
DISCOVERER OF THE FATE OF FRANKLIN
IN 1859."

Mr. Boynton's Proposed Expedition across South America.—As it has been stated through the Press and otherwise, that an expedition which is being organized by Mr. George Melville Boynton, entitled "Discovery Darkest America Expedition," is under the auspices of the Society, the Council desire to state that the Society has nothing to do with the expedition whatever. At the same time, the Council have no means of forming any opinion on the organization or objects of the expedition, or on the competency of its commander.

EUROPE.

Black Rain in Ireland.—The February number of Symons's *Meteorological Magazine* contains a communication from Dr. O. Boeddicker on the subject of a fall of black rain observed in various parts of Central and Western Ireland on October 8 and 9, 1907. The fall was reported, in reply to an inquiry by Lord Rosse, from over thirty different stations, and the rain probably fell over a still larger area. The amount of soot deposited was in many cases so great that rain-water tanks had to be emptied and cleaned, while clothes hung out to bleach were blackened. A disagreeable smell was also noticed at various places. The cloud seems to have come from the south-east, and on the 8th its greatest width from south-west to north-east must have been not less than 110 miles; on the 9th, not less than 80. On the latter day black rain was reported from a point near Westport, on the Atlantic coast (co. Mayo), so that the soot laden cloud, originating probably in South Wales, is shown to have crossed the channel and the whole of Ireland, disgorging its soot into the Atlantic.

The Underground Connection between the Upper Danube and the Rhine.—That the Aach, which enters the Unter See of the Lake of Constance near Radolfzell, derives much of its water-supply by underground channels from the upper Danube, was long a matter of belief, and was actually demonstrated by experiments carried out in 1877. The subject has, however, lately attracted renewed attention, and further experiments by means of chemicals, carried out last year, have set at rest some points which had remained doubtful. A careful study of the whole question has been made, among others, by Prof. K. Endrias, of Stuttgart, who discussed it at the meeting of German naturalists in that city in 1906, and who has given the gist of his paper in a recent number of the *Naturwissenschaftliche Wochenschrift* (1908, No. 7). Another paper, by Dr. C. G. Barth, appeared in the twelfth number of *Petermanns Mitteilungen* for 1907. As might be supposed, the belt of country across which this underground flow takes place is composed mainly of limestone (Jurassic). The Danube water sinks into the ground at various spots on either side of the Baden-Württemberg frontier, but the greatest loss is experienced at the "Brühl," between Immendingen and Möhringen, the volume absorbed here being so great that for a good part of the summer not a drop finds its way down the valley. The upper Danube then belongs wholly to the Rhine system, the water-parting being displaced a considerable distance to the east, while the Danube is forced to find a new gathering-ground in the Swabian Alb. But this is not all, for the experiments of 1907 have proved that a further withdrawal of water takes place near Fridlingen, considerably lower down, this likewise finding its way, by a strange zigzag course, to the Aach. This state of things is favoured by the low level of the Rhine valley, compared with that of the Danube, but from the length of time taken by the low-water stage of the Danube to be felt on the Aach it seems that the water must be stored in an extensive reservoir, possibly due to the same tectonic forces which have created the depression of the Lake of Constance. The withdrawal of water is a serious matter for the town of Tuttlingen and other places on the Danube, and efforts have been made to check it, though these have not unnaturally met with opposition from the dwellers in the valley of the Aach, who benefit by it. It is probable that some of the Danube water also finds its way to the Rhine by the Wutach, which enters below Schaffhausen, and some too, possibly, by a northern route *viâ* the Neckar.

New Route between Sweden and Germany.—It is announced that the Swedish Parliament has recently ratified the agreement with Germany (previously ratified by the Prussian Diet) for the establishment of a powerful ferry service

between the two countries for the purpose of supplying direct railway transport from one to the other. The terminal points of the ferry will be Trelleborg, just west of the southernmost point of Sweden, and Sassnitz, on the Jasmund peninsula of Rügen.

Intermittent Lakes in Russia.—A good deal has been done lately to investigate the "karst" phenomena in Russia, especially in the lake region south of Lake Onega. The results have been published in Russian journals, but have been made more generally accessible in a summary contributed to *Spelunca* (vol. 7, No. 49, 1907) by M. A. S. Vermoloff. The lakes south of Onega have been examined (among others) by M. Kulikoveki, who considers the formation in this region, much of which consists of limestone, to be of Devonian age. Three of the lakes, of which the largest is the Shimozero, communicate by natural channels, though, as they are not filled and emptied simultaneously, the direction of flow in these changes from time to time. The Shimozero discharges its waters into an abyss some 14 miles to the east, which seems to communicate ultimately, by the Megra river, with Onega. By November it is sometimes completely empty, apart from a stream which loses itself in the abyss above mentioned. Another abyss engulfs the waters of the Dolgozero, at the other end of the system, during a portion of the year. A second system of lakes lies a little to the east, and is connected by underground channels with the Bielo-ozero, or White lake, and so with the system of the Volga. The phenomena presented here are almost identical with those already described, the lakes being drained periodically by means of similar abysses, though it is only the Kaino which disappears entirely. In several cases the inhabitants have sought to preserve the fishing by constructing a dam, but in one only with success. Although most of the water of these lakes finds its way towards the Volga system, some probably reaches that of Lake Onega. Not far off, in the Novgorod government, is Lake Druzhino which empties itself, as a rule, at intervals of seven years. The engulftment takes place in the short space of twenty-four hours, and it seems probable that the water finds its way underground to the Bielo-ozero. All the lakes so far mentioned differ from the Lake of Zirknitz (the classical example of an intermittent lake) in not being filled again by the same channel by which they are emptied, but by ordinary, above-ground, agencies, the process sometimes taking as long as seven years. In the case of Lake Siango, in the Arkhangel government, the waters of which are said to disappear with much regularity once in four years, the re-filling takes place with great rapidity within a few days of its emptying, and by the same underground channel. Among other striking features of this region are the instances of streams, the direction of whose flow is reversed according to the state of the water-supply in the lakes with which they are connected.

ASIA.

The Count de Lesdain's Journey across Central Asia.—In 1904 and 1905 the Count de Lesdain and his wife carried out some extensive journeys in the interior parts of the Chinese Empire, in the course of which, thanks no doubt to the effect of the British military expedition of the former year, they achieved the distinction of crossing the whole width of Tibet from north to south, and eventually reaching the plains of India. The journey was referred to at the time in the public press, but no regular narrative was laid before geographical circles until December last, when the count read a paper before the Paris Geographical Society, a summary appearing in the January number of *La Géographie*, the organ of that body. In this abridged form it is not easy to follow the travellers' routes throughout, many of the places visited being spoken of under names that find no place on

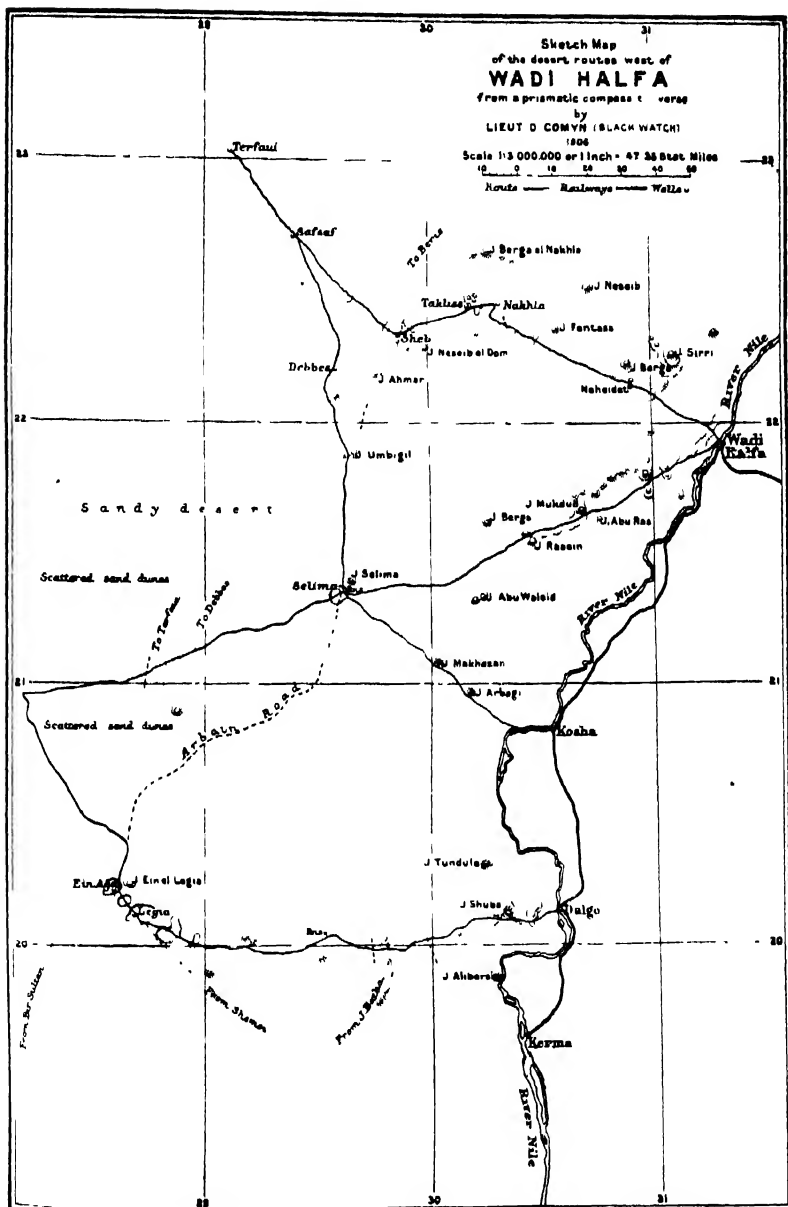
our maps. The first part of the journeys had to do with Mongolia and the Gobi. After visiting the ruins in the Ordos country, the travellers crossed the Hwang-Ho into Alashan, where they likewise examined some ancient tombs and other remains, including those known to the Mongols as Poro Hoto. After going south into Kansu, they once more turned north for Alashan and the Gobi, in which last they visited a place spoken of as Repalaraitsu, and made a survey of the Pua-ho and Lake Tsin-tiu-ru. Large tracts were found to be fertile and cultivated. At Gnansi-chu (Ansi or Ngansi) they made their preparations for the journey across Tibet, on which they finally started with sixty mules and ten drivers, besides four horses and four camels. Traversing the mountains which separate the Gobi from Tsaidam, they crossed the latter (fixing the position of the Dabasun-nor *en route*), and then struck for the sources of the Yangtse,* which they claim to have reached at an altitude of nearly 23,000 feet. Most of the baggage animals succumbed to the difficulties of the route, and before reaching civilization three of their men also died. Crossing the Amdo mountains, they made for the lacustrine region to the south, coming upon the encampments of nomads, but suffering no hindrance from them. Having reached Tengri-nor, they held on their course for Shigatse, and so *viâ* Sikkim to India.

Old Map of Siberia.—Through the courtesy of M. Alexander Gregoriev, the late general secretary and an honorary member of the Imperial Russian Geographical Society, a photograph of a very interesting seventeenth-century manuscript map of Siberia has been added to the Map Room of our Society. This map was found by M. Gregoriev in the old summer residence of Peter the Great at Ekaterinhof, near St. Petersburg, and its existence has been known to him since 1886, although it is only recently that it has been possible to settle the question of its authorship and actual date. As shown by M. Grigoriev in a pamphlet he has written, and a copy of which he has been good enough to present with the photograph, the map was drawn in Tobolsk by a certain Semen Remesov, a self-taught cartographer, by order of Prince Repnin, superintendent of the *Sibirsky Prike*, the department which up to 1763 had to deal with Siberian affairs. This order was issued in Moscow on January 10–20, 1696, and the map was finished and despatched to Moscow from Tobolsk on September 18–28, 1697. The area included in the map extends from the Arctic ocean to the Great Wall of China, and from the Volga to the China sea. Korea is shown in the south-east and the sea of Azov in the south-west corners of the map. The photograph is a reduction measuring 14 inches by 18 inches, but the valuable and interesting original measures about 9 feet by 7 feet. It is painted in colours on a somewhat thick cotton material, and is fairly well preserved. The Czar has now entrusted the map to the custody of the Imperial Russian Geographical Society, where it will doubtless be highly appreciated.

AFRICA.

The Desert west of Wadi Halfa.—Lieut. Comyn sends us some notes on a circular trip made by him in the now little-frequented desert west of Wadi Halfa, with remarks on the possibility of opening up a route across it to Tripoli. His starting-point was Wadi Halfa, whence he struck north-west to Sheb on the old caravan route from Assiut to Darfur (followed by W. G. Browne at the end of the eighteenth century) known as the Darb el Arbain, or "Forty days road." Hence he pushed on in the same direction to a halting-place named Terfaui, from

* The position of these is not stated. Rockhill, who passed very close to them in 1892, placed them in about 83½° N., 91° E.



which point he found it advisable to begin the return journey, which was effected by a circuitous route to the south. A great part of the country traversed is a vast

tableland extending westwards into the depths of the desert, the surface formed largely of vast level tracts of sand, varied by rocky eminences or sandhills. The former are frequently of the sugar-loaf form, but sometimes table-topped, and the sandhills are mostly rounded hummocks known by the name "terabil" (sing. "tarbul"), covered on one side by acacia bushes (Selim or Kitr), though examples of crescent-shaped moving dunes were also seen. The wells, most of which yield a more or less brackish water, are frequently placed in depressions (sometimes bowl-shaped) below the general level of the plateau. The rocks in various places were of the most diverse colours—red, purple, green, yellow, black, etc., and the sand was sometimes a bright red when turned up. Around Bir-el-Sheb ("well of alum") considerable deposits of this substance were seen, and elsewhere there are beds of rock-salt worked to some extent. A block-house still exists at Sheb. At Terfaui evidences were seen that the place had once been an oasis of importance, the remains of camping-grounds pointing to the passage of a great highway. Lieut. Comyn thinks that other oases exist to the north-west, and he points out that as a line of them is known to run south-east from Tripoli, the unexplored gap is only 350 miles in width. On the return the party took a direct route to Selima (where are ruins said to be those of a Christian convent), and then struck west into the desert, crossing two disused roads running north and south. A vast level plain with mirror-like surface extended in this direction, broken occasionally by sand-ridges, and in one part strewn with boulders. A solitary *tundub* tree (*Capparis aphylla*) was also seen. Skeletons of birds strewed the ground in places, and Lieut. Comyn was told that at times flights of birds struggle from the west in an exhausted condition to the wells at Selima. A heavy dew was experienced during the two nights spent on the level plain above referred to. About Ein Aga, where the Arbain road was rejoined, a stony waste, very trying to travel over, took the place of the sand. The plateau seems to have now been left, as its escarpment was seen to the north on the further journey to the Nile, during which some very rocky undulating country was passed. During the greater part of the journey the vegetation consisted of palms (date, dom, etc.), the acacia bushes above mentioned, and of *tuklis* or *halfa* grass; but at Safsaf the grass, curiously enough, was of the kind (*safsaf*) found on the marshy banks of the Nile. It withers when the Nile falls, but becomes luxuriant again with the rise of the river, when the water is almost level with the surface. Some trees formerly grew here, but were cut down in 1894. Gazelles seem fairly abundant, and insect life is described as rife. A pair of falcons were seen on a rocky eminence. Traces of the former presence of man were seen in an old quarry near Legia, in a prehistoric ruin 70 miles east of this, and in a hand-grindstone (for corn) found a little west of Selima.

Colonel Laperrine's Saharan Expedition of 1906.—This expedition, which was referred to some time ago in the *Journal*, was undertaken, it will be remembered, with a view to effecting a junction, in or near Taodeni, with a party from the Sudan under MM. Cauvin and Cortier (*Journal*, vol. 29, p. 346). The narrative of the expedition, given by Lieut. Niéger in *La Géographie* for December, 1907, shows that this crossing of the desert was no less fruitful in results than others of the many traverses by French explorers within recent years. The astronomical and other observations, carried out by Lieut. Niéger, are a useful contribution to the mapping of the Western Sahara, and the general observations on the physical conditions are of considerable interest. It was Colonel Laperrine's original intention to cross by a direct route from Adghar in Tuat to Taodeni, but, the intervening tract being almost unknown, he failed to obtain a guide, and was forced to take a circuitous route farther east, so as to approach Taodeni from the south-east across a narrower stretch of waterless country. The southward portion of the route did not

diverge widely from those of former travellers, though some new bits of country were traversed. Lieut. Niéger makes some interesting remarks respecting the drainage which goes west from the hilly regions of the northern Tuareg country, which seems all to converge on the great Sebkhah or saline basin of Az el Mati, hitherto quite unexplored. Even the Wed Saura, which has its origin a long way north of Tuat, appears to debouch in the same basin, the examination of which will be an interesting piece of work for some future traveller. Between the well-known halting-place of In Zize and the well at Gernen, the route led for five days across the waterless plain of the Tanezruft. After a rest amid the pasturages of Ifafok, where many Tuareg encampments were seen, the expedition struck a little south of west towards Ashurat, over a country broken by rocky eminences, with depressions which receive the drainage from the southern Adrar. Later the weds were of purely local extension, but some contained thick groves of gum trees. The only fodder which grows naturally in these southern regions is the *had*. From Ashurat the route led north-west across the remarkable system of sand-dunes, running regularly from south-west to north-east, already described by Lieut. Cortier (*Journal, loc. cit.*). The absence of wells in this tract may be due in part to the policy of the Tuareg, who are exposed to attack from the Arab tribes to the west and north-west, and are not desirous of facilitating communications. After meeting the southern detachment at El Gettara, and spending some time in the neighbourhood of Taodeni (a great centre of caravan routes, where some valuable information on the region to the north was obtained), Colonel Laperrine set out on the return journey by the direct route to the north-east, for which he had been fortunate in obtaining a guide—probably the only man who knew it. A very broken region—known by the generic term Aukar—had first to be traversed, after which followed the great Erg known as Shash, which in its main features resembles the Igidi west of Tuat. It is at present practically deserted, and the party experienced considerable hardships, for the wells were in a neglected state and gave only brackish water, though the route was once much more frequented. In itself, however, the Erg presents no insurmountable difficulties to those who know it well. The first of the Tuat oases was reached on July 9.

The Duke of Mecklenburg's Expedition to East Central Africa, the organization which was announced in the *Journal* a year ago, arrived, during the course of last summer, in the region of Lake Kivu, whence, as also from points touched at earlier, the leader has sent home accounts of the work so far accomplished. Those have appeared in the *Täglich Rundschau*, extracts being also reproduced in the *Deutsches Kolonialblatt* (February 1, 1908), and at less length in the *Zeitschrift* of the Berlin Geographical Society (1908, No. 1). The Duke is accompanied by a number of experts, who, besides surveys, are carrying out zoological, geological, ethnographical, and other researches. Bukoba, on the Victoria Nyanza, was reached on June 9, the westward march being resumed on the 19th. Different sections of the expedition surveyed different districts on or near the course of the Kagera, a new tributary of which river was discovered in the region between it and the Lubogora. Passing through Ruanda, the expedition reached the military post of Kissenye, from which, as a centre, explorations of Lake Kivu and its neighbourhood were carried out. A strong surf was noticed on the lake-shore each evening, there being no wind at the time to account for it, and it is suggested that it has some connection with the volcanicity of the region to the north. Investigations were made into the fauna and flora of the lake and its islands, the former proving markedly poor in species, which is in harmony with the idea of its recent origin. Dr. Kirschstein, the geologist of the party (who, in company with Lieut. Weiss, had previously examined the bush-steppe south of Mpororo, finding it a much-broken

mountain country much resembling Karagwe), discovered on the north-east and north shores of the lake remains of a now extinct fauna, which, he thinks, may throw light on its history. His studies of the volcanoes led him to conclude that their activity is dying out progressively from east to west, being at present greatest in the case of Namdagira. Studies of the fauna of these mountains were made by Dr. Schubotz. In October the duke was planning to proceed through Congo territory to Lake Albert Edward.

Coetivy transferred to the Seychelles.—By letters patent dated January 13, 1908, the small island of Coetivy, lying to the south-south-east of the main portion of the Seychelles group, has been united with that protectorate, having previously remained attached to Mauritius. As was pointed out by Mr. Gardiner in his paper on the Seychelles (*Journal*, vol. 29, p. 148), the reason for its so remaining when the Seychelles proper were separated from Mauritius in 1903 was the fact that its proprietor (like that of Farquhar to the south-west) belonged to the more southern colony. It may be presumed that the transfer of Farquhar will only be a matter of time.

AMERICA.

Region of the Colorado Delta: Latest Changes.—The exceptional phenomena presented by the sudden irruption of the Colorado into the Salton basin have afforded a fruitful field for study, of which advantage is being taken by more than one organization. A beginning was made early in 1907 by Mr. D. T. MacDougal in connection with the Desert Laboratory of the Carnegie Institution, and it is proposed to continue the investigations during the recession of the Salton lake, with a view to observing the movements and behaviour of plants in the occupation of a denuded area. The preliminary expedition, during which the Salton lake was circumnavigated, and the second basin to the west of the Cucupa mountains explored, has already supplied interesting data on the physical conditions of the region, which are described by Mr. MacDougal in the *Bulletin* of the American Geographical Society for December, 1907. Many samples of the water of the Salton lake and also of the Colorado river were collected, analyses showing that, while the constituents of the lake water approximate more nearly to those of the river than of sea-water, there is still a difference in character between the two former, which seems to show that the soluble matters in the lake are not derived exclusively from the Colorado. A large part of the floor of the basin was occupied by saline deposits, and during its filling (in which the water-level rose altogether 72 feet between November, 1904, and March, 1907) a marked difference was found between the amount of salts carried at different points, the shallower portions showing a much greater degree of concentration, though eventually the action of currents, etc., brought about a much greater uniformity. When at its highest the lake occupied an area of between 600 and 700 square miles, its margin presenting a singular aspect owing to the absence of any real beach, and the encroachment of the water on the desert vegetation. Long tongues of water sometimes extended from the general shore-line into barrancas cut in the sides of the basin, and in these the swell of the lake would be converted into oscillating currents. Observations of relative humidity proved that, while on the immediate shore this might reach 80 or 90 per cent., it would have fallen to 49 per cent. at 1000 yards' distance, beyond which the unchanged aridity of the desert was soon encountered. Any effect on vegetation would therefore be limited to the immediate vicinity of the shore. Mr. MacDougal's trip west of the Cucupa ridge showed that the basin of the Maquata lagoon (for which he proposes the name Pattie basin, after the trappers of that name who traversed it in 1828) is also an ancient arm of the

gulf, and that it, like the Salton, is an integral part of the delta. The lake is filled more frequently than the Salton, the flood-water making its way into it from the main western arm of the Colorado round the southern end of the Cucupa range in a shallow sheet 10 to 12 miles wide. In a more recent note in the *National Geographic Magazine* (January, 1908), Mr. MacDougal reports that a new main mouth has been formed by the Colorado on the east side of the head of the gulf, the channel utilized being an occasional flood channel to which he had called attention in 1906 (*Journal*, vol. 21, p. 631). This is likely to have important consequences, including a probable blocking of the previous main mouth, and a reduction of the force of the tidal bore. Another investigation is to be carried out at the Salton lake by the U.S. Weather Bureau for the purpose of elucidating the conditions of evaporation. Some preliminary experiments at Reno, Nevada, described by Prof. F. H. Bigelow in the same number of the *National Geographic Magazine*, point to a necessary modification of current ideas, it being shown that the process may be greatly retarded by the vapour blanket formed immediately above the water surface.

Santa Cruz Island, West Indies.—Under the title 'The Building of an Island' (Christiansted, 1907), Mr. John T. Quinn discusses the geological history of Santa Cruz, at the north-east corner of the Caribbean sea. With a length of 22 miles, and a breadth of 6, the island has an area of 80 square miles, or three-quarters that of the Isle of Wight. It rises abruptly from the sea on the north, but on the south the 100-fathom boundary-line encloses a further area as great as that of the island. The west end of the island is an oblong, while a low neck joins it to the triangular east part. The west oblong is hilly, Blue mountain rising to 1100 feet. The east triangle rises from the intervening neck in ranges 800 feet high, and parallel to those of the west oblong. The lowland neck is formed of limestone and marl—stratified and foraminiferous. On each side, viz. through the east triangle and the north-west oblong, the geological formation is known as "blue beach." It is composed of clay and quartz, and is older than the limestone of the plain. The "blue beach" formation has been folded by forces acting from the north-north-east, while other forces have acted crosswise. It is essentially a clay formation, which, though ultimately igneous, has been stratified by the action of the sea. Later its configuration has been modified by heat and water. Crystalline forms occur, with frequent jointing and cleavage. In the central plain proofs of sinking are found. When the mountain crests were planed away, the land sank and was covered with limestone and marl deposits, which lay upon the upturned edges of the strata. Igneous dykes occur in this section, but there are no valuable metal ores. The valleys of the island have been carved out of the uplifted strata, of which the hills are the remnants. The denuding influence is chiefly the rainfall, which is about 50 inches, or double that of the Thames valley, though the thick vegetation protects the land from weathering to some extent. Santa Cruz lies at the east extremity of the Antillean chain, which stretches from west to east, and of which Porto Rico, Cuba, and Jamaica show signs of a similar geological history, e.g. limestone formations on the seaward slopes. If, with Dr. Spencer, we regard the West Indies as a sunken plateau connecting North and South America, the island takes its place as an unsubmerged relic of this vast area.

AUSTRALASIA AND PACIFIC ISLANDS.

Dutch New Guinea.—An account is published in the *Tijdschrift* of the Dutch Geographical Society, Deel xxv., No. 1, of the Lorentz expedition which last autumn set out from Oostbai, on the south coast, up the North river with the

object of reaching the Sneeuwgebergte (Snow mountains) lying to the east of the isthmus formed by Geelvinck bay. The furthest camp was pitched on the ridge of the Hellwiggebergte at a height of 2170 metres (7100 feet), where a fine view was obtained of several mountain groups. The height of the Herwerden-Top, 17 miles distant, was estimated at about 5000 metres (16,400 feet). This summit, like the Snow mountains, is visible from the sea. The latter were not visible from the camp, but from elevations observed on the route were estimated to rise to 5000 metres, or 100 metres less than the height calculated by Meyjes. A higher point on the Hellwig mountains, about 7600 feet, was reached, lying roughly in $4^{\circ} 29' S.$ lat. and $138^{\circ} 50' E.$ long. The expedition here turned back, owing to scarcity of provisions, the distance from the sea in a straight line being about 85 miles.

The Magnetic Survey of the Pacific, by the U.S. ship *Galilee*, was continued during 1907, and is now approaching completion. From a statement in *Science* of January 17 we learn that the *Galilee*, which had left San Francisco in December, 1906 (as previously, under the command of Mr. W. J. Peters), made the tour of the Pacific by way of the Marquesas, Samoa, Shanghai, Alaska, Hawaii, etc., to New Zealand, arriving at Lyttelton on December 24 last. A determination of the three magnetic elements was made about every 200 or 250 miles along the entire route, while comparisons between the ship's instruments and those of observatories on the route were secured. It was expected that the *Galilee* would reach San Francisco *via* Peru about May 1, bringing to a close cruises amounting to a total of some 65,000 miles.

POLAR REGIONS.

Mr. Shackleton's Antarctic Expedition.—The ship *Nimrod* returned to New Zealand early last month after landing Mr. Shackleton and the other members of the expedition who are wintering in the Antarctic on the shores of Ross island. From a lengthy despatch by Mr. Shackleton, which has been cabled to a London newspaper, it appears that the *Nimrod* was badly strained during the storms encountered after the expedition left Lyttelton, and that members of the scientific staff as well as the crew had to take their turn at the pumps. The *Koonya* towed the expedition till ice was sighted, and gained the distinction of being, if Mr. Shackleton is not mistaken, the first steel steamer which has crossed the Antarctic Circle. After the departure of the *Koonya*, the course of the *Nimrod* was directed south along the 178th meridian of west longitude. For several hours on the following day (January 16) the vessel had to thread her way among large icebergs, but the open waters of the Ross sea were reached without any sign of the pack-ice through which previous expeditions have had to force a passage. The ice-barrier was sighted on January 22, and the expedition then turned eastward to carry out Mr. Shackleton's intention to establish winter quarters on King Edward VII. Land. Mr. Shackleton reports, however, that access to the land in this direction was barred by the ice. Repeated spells of bad weather were experienced, and at last he decided to make for McMurdo sound, at the other end of the ice-barrier. Here winter quarters were established on Cape Royds, under the shadow of Mount Erebus, about 20 miles north of the *Discovery's* winter quarters. The landing of the motor-car, ponies, dogs, and other equipment was not accomplished without difficulties, and once the *Nimrod* was blown out to sea in a blizzard with the temperature 16° Fahr. below zero. On the voyage north, however, the *Nimrod* had an excellent run, leaving the winter camp on February 22, and arriving at Port Chalmers on March 6. The landing-party appears to be fifteen strong, having been joined by Prof. David, of Sydney; Mr. Marson, a chemist and physicist, of

Adelaide; and Mr. Armytage, a hunter and traveller, of Melbourne. Since the *Discovery* expedition the region around McMurdo sound is not virgin territory in the same sense that is King Edward VII. Land, but there is plenty of room for interesting scientific work, and no doubt a big effort will be made to reach the pole. The *Nimrod* is to return for the explorers at the beginning of next year. It is reported that Captain England has resigned his command, and according to a telegram from Wellington, it is doubtful whether the magnetic survey in the Indian ocean, which was allotted as the work of the *Nimrod* during the coming year, will be undertaken.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Nieve Penitentes.—Subsequent to the reference to this subject at our meeting in January, a long and interesting discussion on it was held at a meeting of the Research Branch of the Berlin Geographical Society on February 8 last. The subject was introduced by papers from Dr. Hauthal and Dr. Hans Meyer, recording their observations in the Andes, and from Dr. Fritz Jaeger, giving his experience on Kilimanjaro.* Dr. Meyer points out that the original form of the phrase used to describe the singular rows of snow-pinnacles observed in tropical ranges was *nieve de los penitentes*, and that the proper abbreviation is *nieve penitente*. He prefers, however, to find a German name. Dr. Hauthal suggests *Büsserschnee*, the literal translation of the Spanish phrase, while Dr. Meyer would substitute the more precisely descriptive *Zackenfirn* = "snow-teeth." The papers are illustrated by photographs exhibiting very clearly the phenomenon in its different stages, from a hummocky snowfield to isolated and tottering spires and pinnacles. The evidence shows that the first stage is a series of ridges in the snowfield running in all cases in an approximately south-east and north-west direction. These ridges soon break up into pyramidal forms or sharp cones and spikes ranged in rows corresponding to the ridge they represent with an almost regimental regularity. Their height is ordinarily from 4 to 6 feet. Dr. Meyer narrates how, on Chimborazo, he was able to watch these "snow-teeth" in process of formation at an interval of seven weeks. During this period the mountain had been enveloped in clouds during the hottest part of most days. He therefore believes that the cause of their formation should be found rather in hot winds than in sunshine. Similar snowy formations were seen by Dr. Jaeger on Kilimanjaro. He considers that after eight days' fine weather he recognized on the Tschingel-Firn in the Bernese Oberland snow-ridges similar on a small scale to those in which the snow-teeth originate. In the discussion that followed, Herr Meyer allowed that sun more often than wind was the cause of the phenomenon. Very various views were expressed by the different speakers as to the cause of the ridges out of which the snow-teeth are formed. Some alleged differences in the internal structure of the snowfield, others the action of heat-absorbent dust on its surface, and others wind action. The prevailing opinion, however, seemed to be that the two causes which had most effect were long seasons without snowfall and a vertical sun, the rays of which fell on the bottom of the hollows and converted them into troughs. The pinnacles appear to be protected in many cases by icy caps, thus to a certain extent resembling earth-pillars in the cause of their prolonged duration. No reference was made during the discussion to Mr. Cornish's elaborate researches into snow-waves and ripples (see *Geographical Journal*, vol. 20, No. 2). Surely these furnish an adequate theory of the origin of the ridged structure which serves as a basis for

* A summary of various previous discussions of the phenomenon was given in the *Journal* for July, 1905, p. 91.

the snow-teeth, or *nieve penitente*. In this case the original formation of the ridges would be attributable to wind (except in steep gullies and slopes where other causes may be efficient), and their subsequent development and conversion into snow-teeth to the influence of the equatorial solar rays.

Investigation of Earth-movements.—An inquiry has been set on foot by the 'Zentralkommission für Wissenschaftliche Landeskunde in Deutschland,' through Dr. G. Braun, of Greifswald, with a view to the collection of exact observations on the subject of Earth-movements of various kinds. Dr. Braun has issued a circular (addressed primarily to the German-speaking peoples), in which he points out the importance of the study of Earth-movements (landslips, mud-streams, or the slow movements only noticeable through their results) in connection with many problems of physical geography, and asks for particulars of such occurrences (including newspaper and other cuttings in which they are, however briefly, described) to be sent to him at the Geographisches Institut, Greifswald. The letter is accompanied by a schedule of questions in regard to the points on which information is needed.

GENERAL.

The Oxford School of Geography.—The recent development of this school, and the ever-growing claims upon it, have made it necessary to appeal to the Common University Fund for further financial assistance for the year 1908-9. This, we are glad to learn, has been forthcoming in the form of a grant of £200, which will enable the needed additional assistance to be supplied. In connection with the application, a memorandum to the Chancellor of the University was drawn up, and this, which has since been printed, gives a clear statement of the various activities of the school, and the directions in which they need to expand. It shows that the value of the school is meeting with wide recognition, and that a fruitful field lies before it, not only in the supply of a geographical training to teachers and those about to engage in public work of various kinds, but in the promotion of research and the dissemination of knowledge regarding existing geographical conditions throughout the world. The report for 1907, which has also been issued, records a steady progress, and it is satisfactory to note that the number of students on the roll showed a slightly rising level throughout the three terms, instead of displaying the fluctuations sometimes seen in the past. It may be mentioned that, besides the diploma of the school, certificates are given for proficiency in certain parts of the whole examination, and that a certificate in Regional Geography is recognized as the equivalent of one of the subjects of Group B for the final school for the pass B.A. degree. The equipment of the school is being constantly improved so far as means allow.

Jubilee of the Geneva Geographical Society.—This Society celebrates, during the present year, the fiftieth anniversary of its foundation. It is felt that the meeting of the Eighth International Geographical Congress in that city, in the preparations for which the society is taking the leading part, will be an appropriate memorial of the event; but in order not to pass over the actual date of the anniversary, it was decided to commemorate the occasion, in a more simple manner, at the society's meeting on March 27, which has therefore been devoted to this object.

The Ninth International Geographical Congress.—Further particulars of the arrangements for this Congress (see *Journal*, vol. 30, p. 337), which is to be held at Geneva from July 27 to August 6, are issued by the Organizing Committee. Down to the middle of February the invitation to send delegates had been accepted by the governments of eleven countries (nine European countries, the United States, and Brazil), by twelve universities and scientific teaching institutions, by

sixty-three geographical and kindred societies, and by eleven other bodies. Our own Society has appointed as its representatives, Major C. F. Close, Mr. G. G. Chisholm, and Dr. J. Scott Keltie. Oxford University is sending Dr. A. J. Herbertson and Prof. J. L. Myres; and Cambridge University, Mr. H. Yule Oldham, Dr. F. Guillemard, and Dr. A. C. Haddon. Delegates are also being sent by the Royal Scottish Geographical Society, the Manchester Geographical Society, the Geographical Association, the Royal Asiatic Society, the Palestine Exploration Fund, and the Egypt Exploration Fund. The fourteen sections in which the members of the Congress will meet are already provided with promises of 188 papers and reports. These include contributions by Sir Clements Markham, "On the Region of the Andes from Cuzco to Tiahuanaco, and on recent discoveries of Courses of Rivers to the Eastward;" Sir John Murray, who has accepted the presidency of the oceanographical section, on "The Floor of the Ocean;" Dr. H. R. Mill, "On the Relation of Rainfall to the Configuration of the Land;" Captain R. F. Scott, "A Consideration of the Methods of Travelling on the Antarctic Continent;" Dr. A. J. Herbertson, "Natural Divisions of the Earth's Surface and their Value in Education;" Captain H. G. Lyons, "The Survey of Egypt;" and Dr. J. Scott Keltie, "A few words on Recent Geographical Progress in England." Others who are expected to take part in the Congress include Prof. W. M. Davis, who will preside over the section devoted to the teaching of geography; Prof. Henri Cordier, president of the section devoted to historical geography; Dr. G. Hellmann, Count Joachim von Pfeil, Prof. A. Penck, Mr. C. Raymond Beazley, Mr. J. G. Bartholomew, Prof. Levasseur, and Prof. Libbey. It is noteworthy that in the section set apart for the discussion of questions relating to exploration, all but three of the thirteen papers promised are concerned with the polar regions. Apart from Captain Scott's paper, Captain Roald Amundsen is to give an account of his projected expedition for the exploration of the north polar-basin; Mr. Henryk Arctowski, a paper on the physical geography of the Antarctic regions; and Dr. Jean Charcot, a paper showing the need for the exploration of the south polar regions. A summary of the results of recent French explorations in Africa is promised by Baron Hulot, the secretary to the Paris Geographical Society. We referred at some length last September to the scientific excursions which are being planned in connection with the Congress. In their present statement of plans the Organizing Committee point out that it should be clearly understood that these excursions are not designed as pleasure-trips. Some will involve alpine difficulties of a serious order, and none should be undertaken save by those prepared for rough work in mountainous country.

OBITUARY.

Dr. A. W. Howitt, C.M.G.

THE death of Dr. A. W. Howitt is reported as having occurred at Melbourne on March 8. The deceased, who was born in 1830, was the elder of the two sons of the well-known writers, William and Mary Howitt. Accompanying their parents on a visit to Australia in 1852-54, the brothers both took part in pioneer work, either there or in New Zealand, the elder becoming known some years later as the leader of the Victorian Expedition in search of the missing explorers Burke and Wills, whose tragic fate he was thus the means of ascertaining. Settling in Victoria, Howitt held various public posts in that colony, and in later life paid considerable attention to the study of the Australian aborigines, on which subject he brought

out a book only some four years ago under the title 'The Native Tribes of South-East Australia' (Macmillan, 1904).

Captain G. N. Conlan.

The Society has lost a Fellow of thirty years' standing in the person of Captain George Nugent Conlan, Marine Superintendent of the Pacific Steam Navigation Company. Captain Conlan had been in the service of the company for forty-seven years, and his great practical experience as a sailor was highly valued by his employers. He was much interested in the study of ocean currents, and contributed to its furtherance during his many voyages by frequently throwing over bottle-papers, some of which were recovered many miles from the spots at which they had been dropped. His death occurred at Liverpool towards the end of last year.

CORRESPONDENCE.

The Mapping of Lake Chad.

THE letter which "A. K." has addressed to the *Geographical Journal* on the subject of my review of Mr. Boyd Alexander's work (dealing, amongst other things, with his expedition and survey of Lake Chad) does not seem to me to be altogether fair, either to the reviewer or reviewed. A. K.'s initials may indicate one who is at the fountain-head of official geographical information. If that is so, he has been misled, I think, by his own facilities into imagining that the general public (from whose standpoint I reviewed Boyd Alexander's book) has been equally well informed on the subject of the progress of Lake Chad exploration and survey.

Such, I am sure, is not the case. Until Mr. Boyd Alexander read his paper before the Royal Geographical Society a year ago—a paper of which the book and maps in question are merely a fuller development—I cannot recall any publication which gave as complete and truthful a map of Lake Chad as has resulted from the surveys of Mr. P. A. Talbot and the other members of the expedition conducted by Mr. Boyd Alexander.

The Intelligence Division in England and in France, before the publication of the Boyd Alexander expedition surveys, had no doubt realized the actual geography of Lake Chad; but that the French (for whom A. K. claims the principal merit of the existing results) have been in no hurry to make public the results of their researches is evident. I have before me now for review a most interesting work written by M. Auguste Chevalier, 'L'Afrique Centrale Française: Mission Chari-Lac Tchad, 1902-1904.' The publication date of this book is 1908; nevertheless, M. Chevalier and his colleagues still issue a map containing a Lake Chad of the old design, with the dotted lines round much of the margin, and showing the familiar but now incorrect version of the lake—a continuous sheet of water merely studded with islands (their own surveys having been executed farther south and east).

I believe, also, that I am correct in my main thesis, which was, that prior to the publication of the results of the Boyd-Alexander Expedition Lake Chad—so far as published documents were concerned—was in parts entitled to a dotted outline only, however precise may have been those surveys of portions of the shores and islands alluded to by A. K.

H. H. JOHNSTON.

I am afraid that some remarks which I have made in my book, 'From the Niger to the Nile,' regarding my determination of the size of Lake Chad in comparison with its area as shown on former maps, have misled my kind reviewer to claim too much for the work of our expedition in that region.

When we were engaged upon the exploration of the lake (December, 1904, to May, 1905), of course there was no complete map more recent than Barth's, which we reconstructed, reducing the distance across the north from some 60 to 30 miles, and that across the south from 90 to 45 miles. On my return home (February, 1907), I found that the French Geographical Society had published a map the year before, establishing pretty generally these facts, and I can only say now that I am sorry that I have not made this acknowledgment to them before, but my attention was engaged on the fact that, although the French had more or less determined the size and shape, it was my report sent home from the Shari and published in the *Geographical Journal* for November, 1905, which first established the separation of the lake into two basins; whereas Major Lenfant's map, published at the end of May, 1904, showed a clear waterway between the two parts at least 20 miles wide, so that the subsequent division by the French of the lake into two basins (though they do not go so far as I in claiming that there is no communication) was published a year after I had placed my information in the hands of our Geographical Society.

While making this claim for the work of the Alexander-Gosling expedition, and in consideration of the tone of "A. K.'s" letter, I think it would be as well to state what other new work was done by us upon the lake.

There was—

(a) The careful mapping of the whole of the northern portion of the lake lying between the Yo mouth and Kaddai. This was published in the *Geographical Journal* for March, 1905.

(b) Fixing by latitude the position of the Yo mouth, and also of two points on the east coast of the lake.

(c) The astronomical determining of the position of Kaddai.

(d) Five traverses of the lake, with the mapping and naming of many islands, and a record of soundings.

In closing, I think I might be pardoned for remarking that when I remember those six months' work upon the lake that went to produce the map recording these things, not to mention the unique collections of birds and fish (the latter raising speculations of important geographical interest), and then read "A. K.'s" final dismissal of our labours as merely "some additional routes," I cannot help feeling that a little more generosity would have better become the modesty of his signature.

BOYD ALEXANDER.

'Life and Voyages of Joseph Wiggins, F.R.G.S.'

I wish to draw attention to two or three mistakes in the review of the above book which appeared in the February issue of the *Geographical Journal*.

The writer, "C. R. M." (whose identity is evident), states, with reference to the first voyage of Captain Wiggins, that he "succeeded in raising funds to buy and fit out the steamer *Diana*." The captain chartered, fitted, and manned the *Diana* entirely at his own expense, as set forth plainly on p. 23 of the book. He neither asked for, nor received, a penny towards the expense. He drew upon his hard-earned savings, and was under obligation to no one.

Further on it is asserted that the *Phoenix* was "hopelessly stranded." This is

not so. The captain took the ship, with a British cargo, for about 2000 miles up the Yenesei—a river which had never been surveyed, and on which there were no buoys, beacons, or other signals—to Yeneseisk without any serious mishap. In the following year the *Phoenix* went down the river, in charge of the captain's brother, for the purpose of meeting the *Labrador* at Golchika, situated at the mouth of the river, and exchanging cargoes with that vessel, the *Labrador* drawing too much water to risk taking her to Yeneseisk. Unfortunately, the *Phoenix* got stranded on the journey, but for a few hours only, and she reached Golchika in safety. A telegram, greatly exaggerating the accident on the sandbank, and giving the impression that the *Phoenix* was lost, reached the captain in Norway, whence he was about to proceed with the *Labrador* to Golchika. The English syndicate at once looked for a small vessel to accompany the *Labrador* and convey her cargo up the river. The vessel despatched by the syndicate turned out to be a frail paddle-steamer, much to Wiggins's disappointment. However, the two ships started from Norway. The little steamer was lost sight of in a gale, and she returned to Vardoe before getting even as far as Waigatz island. Wiggins spent many days in a fruitless search for her. With no craft to carry his cargo up the river, and believing the *Phoenix* to be lost, and, moreover, with winter approaching, it was useless for him to continue the voyage, and he therefore sailed homewards. The *Phoenix*, in the meanwhile, had been waiting at Golchika, and before winter set in returned safely to Yeneseisk. It was clearly from no fault of Wiggins that this voyage of the *Labrador* proved a failure.

Again, it is stated in the review that "from 1890 to 1894 Captain Wiggins was connected with Mr. Popham's ventures, reaching the Yenesei twice, but again losing his vessel." If only in fairness to Captain Wiggins, it might have been stated that the *Stjernen* was lost under circumstances entirely beyond the control of the most experienced and skilful mariner in the world.

I am afraid that any one reading the review, and having no previous knowledge of the captain, would come to the conclusion that the English mariner considerably overrated his abilities, and lost three vessels as the penalty of his rashness, contriving to make only one successful voyage—that of the *Warkworth* to the Obi in 1878.

I am quite sure that it never entered the mind of "C. R. M." to disparage in the smallest degree the well-earned reputation of Captain Wiggins. He will not, therefore, deem the above corrections and explanations superfluous or uncalled for.

I may take the opportunity of noting that, according to "C. R. M.", the extent of the Kara sea widely differs from that laid down by generally accepted authorities. He says, "It is a shallow gulf, 320 miles long and 160 miles across." According to various charts and maps, it lies between meridians 58° and 77° E., and parallels 69° and 76° N., making the length of the sea about 1000 miles, and the distance across about 400 miles.

HENRY JOHNSON.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907-1908.

Eighth Meeting, February 24, 1908.—The Right Hon. Sir GEORGE T.

GOLDIE, K.Q.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*Thomas Richard Bayliss, J.P.; Harold Cooke Gutteridge, M.A.; Edward Huntington Leaf; James Mellor; Douglas Arthur Reid; Thomas Douglas*

Scott; John Bensley Thornhill; Lionel Truninger, C.I.E.; L. F. Barrington Weldon; Lancelot Wilkinson.

The paper read was :—

"Travels in the Old Kingdom of Congo." By the Rev. Thomas Lewis.

RESEARCH DEPARTMENT.

February 21, 1908.—Major C. F. CLOSE, C.M.G., R.E., in the Chair.

1. "On Stereo-Photo Surveying," with demonstration. By Lieut. E. Vivian Thompson, R.E.
2. "A New Distance Finder," with demonstration. By E. A. Reeves.

Ninth Meeting, March 9, 1908.—The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—John George Adams; Frank Bowden; Frederick Charles Chapman; William Erasmus Darwin, M.A.; Captain Charles Robert Hall (Royal Munster Fusiliers); John Flower Hepworth; Harold M. Lomas; Rev. William Edward Soothill.

The paper read was :—

"Exploration in Southern Nigeria." By Lieut. E. Steel.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., Librarian, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full :—

A. = Academy, Academie, Akademie.
 Abh. = Abhandlungen.
 Ann. = Annale, Annales, Annalen.
 B. = Bulletin, Bollettino, Boletim.
 Col. = Colonies.
 Com. = Commerces.
 C.B. = Comptes Rendus.
 E. = Erdkunde.
 G. = Geography, Géographie, Geografia.
 Ges. = Gesellschaft.
 I. = Institute, Institution.
 Iz. = Izvestiya.
 J. = Journal.
 Jb. = Jahrbuch.
 k.k. = kaiserlich und königlich.
 M. = Mitteilungen.

Mag. = Magazine.
 Mem. (Mém.) = Memoirs, Mémoires.
 Met. (mét.) = Meteorological.
 P. = Proceedings.
 R. = Royal.
 Rev. (Riv.) = Review, Revue, Rivista.
 S. = Society, Société, Selskab.
 Sc. = Science(s).
 Sitzb. = Sitzungsbericht.
 T. = Transactions.
 Ts. = Tijdschrift, Tidskrift.
 V. = Verein.
 Verh. = Verhandlungen.
 W. = Wissenschaft, and compounds.
 Z. = Zeitschrift.
 Zap. = Zapiski.

On account of the ambiguity of the words octavo, quarto, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 x 8½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Phytogeography.

Schroeter.

Das Pflanzenleben der Alpen. Eine Schilderung der Hochgebirgsflora von Dr.

C. Schroeter Zürich: A. Raustein, 1908. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. xvi. and 808. *Maps and Illustrations*. Price 17m.

This valuable work, which has appeared in parts, is now complete. It will be reviewed elsewhere.

Austria—Lower Austria. *G. Jahrb. Österreich* 5 (1907): 1-64. Zündel.

Talgeschiehtliche Studien im unteren Traisengebiet (Niederösterreich). Von Frau Ambros Zündel. *With Maps and Sections*.

Austria—Silesia. Handlik.

Petermanns M., *Ergänzungsheft* 158 (1907): pp viii. and 116.

Kulturgrenze und Kulturzyklus in den polnischen Westbeskiden. Eine prinzipielle kulturgeographische Untersuchung von Dr. Erwin Handlik. *Maps and Illustrations*.

Baltic—Cartography *Riv. G. Italiana* 14 (1907): 449-475. Bellio.

Alcune osservazioni sulla cartografia medievale del Mar Baltico: Del Prof. V. Bellio. *Map*.

Europe—Historical. Moryson.

An Itinerary, containing His Ten Yeeres Travell through the Twelve Dominions of Germany, Bohmerland, Sweitzerland, Denmark, Poland, Italy, Turkey, France, England, Scotland, and Ireland. Written by Fynes Moryson. Vols. 3 and 4. Glasgow J. MacLehose & Sons, 1908. Size 9×6 , pp. (vol. 3) x. and 500; (vol. 4) x. and 522. *Facsimile, Plans, and Illustrations*. Price 12s. 6d. *net per vol.* Presented by the Publishers

The work is now complete.

France—North-West. Féllice

La Basse-Normandie: étude de géographie régionale. Par Raoul de Féllice. Paris: Hachette et Cie., 1907. Size $10 \times 6\frac{1}{2}$, pp. 598. *Maps and Diagrams*. Price 9s. 9d.

France—Paris. Marcel.

Le plus ancien plan de Paris et les dérivés italiennes du plan d'Arnoullet. Par Gabriel Marcel. (Extrait du 'Bulletin de la Société de l'Histoire de Paris,' etc., tome xxxiv., 1907.) Size $9\frac{1}{2} \times 6$, pp. 12

France—Population *B.S.G. Marseille* 31 (1907): 5-31. Barré.

La répartition des centres de dépopulation et d'infécondité dans la France métropolitaine. Par H. Barré

France—West *Ann. G.* 16 (1907): 204-222. Welsch.

Le Haut Poitou. Par Jules Welsch. *With Map*.

France—West Coast *Ann. hydrographiques* 28 (1907): 247-314. La Porte.

Triangulation de Brest à la Loire. Par F. la Porte. *With Diagrams*.

France—Yonne. *La G., B.S.G. Paris* 16 (1907): 209-224. Privat-Deschanel.

L'habitation humaine dans le Sénonais. Par Paul Privat-Deschanel. *Illustrations*.

Germany—Pomerania. Deecke.

Geologie von Pommern. Von Dr. W. Deecke. Berlin Gebr. Borntraeger, 1907. Size $10 \times 6\frac{1}{2}$, pp. viii and 302. *Maps and Illustrations*. Price 9.60m. Presented by the Publishers

An excellent guide to the evolution of the present surface features

Germany—Schleswig-Holstein. Engelbrecht.

Bodenbau und Viehwand in Schleswig-Holstein, nach den Ergebnissen der amtlichen Statistik. . . dargestellt von Th. H. Engelbrecht. Two parts. Kiel, 1905-1907. Size $10\frac{1}{2} \times 7$, pp. (part i.) viii and 308; (part ii.) viii. and 232. *Maps*. Presented by the Landwirtschaftskammer f. d. Provinz Schleswig-Holstein

Iceland *Petermanns M.* 53 (1907): 177-188. Schneider.

Beiträge zur physikalischen Geographie Islands. Von Dr. Karl Schneider.

Deals with the physical history of the island.

Italy—Apennines. *Z. Ges. E. Berlin* (1907): 441-472, 510-588. Braun.

Beiträge zur Morphologie des nördlichen Apennin. Von Dr. Gustav Braun. *Sketch-maps, Illustrations, and Sections*.

Italy—Meteorology. *B.S.G. Italiana* 8 (1907): 738-745. Palazzo.

I brontidi del bacino bolognese. Del Prof. Luigi Palazzo

- Italy—Sardinia.** *B.S.G. Marseille* 31 (1907): 32-51. **Gaffarel.**
La Sardaigue. Par Paul Gaffarel.
- Italy—Vesuvius.** *C.R.A. Sc. Paris* 144 (1907): 1245-1251. **Lacroix.**
Sur la constitution pétrographique du massif volcanique du Vésuve et de la Somma. Par M. A. Lacroix.
- Mediterranean.** [Rhodes.]
Six weeks and the Mediterranean. By "Passenger" [Thomas Rhodes] London: G. Philip & Son, [not dated]. Size 6 x 7, pp. 186. *Maps and Illustrations.* Price 1s. net. Two copies, presented by the Author and Publisher.
- Norway.** **Biedma.**
La tierra del sol de media noche. Por el D Carlos María Biedma. Paris, etc., 1908 [1907]. Size 8 x 5½, pp. 74. *Maps and Illustrations.* Presented by the Author.
- Pyrenees.** *La G., B.S.G. Paris* 16 (1907): 163-170. **Rabot.**
La dégradation des Pyrénées et l'influence de la forêt sur le régime des cours d'eau. Par Charles Rabot.
- Russia—Waterways.** ———
Deutsch. Rundschau G. 29 (1907): 118 126, 213-223, 309-319, 359-367, 461-465.
Die militärische Bedeutung der Wasserstrassen des europäischen Russland. Aus dem "Wojennuj Sabornjik" (Militärarchiv) übersetzt von Oberleutnant Oskar Muszyuski v. Arenhort. With *Maps.*
- Spain and Portugal.** **Baedeker.**
Spain and Portugal: Handbook for travellers. By Karl Baedeker. Third edition. Leipzig (London: Dulau & Co.), 1908. Size 6½ x 4, pp. xvi. and 588. *Maps and Plans.* Price 16s. Presented by the Publishers.
- Spain—Phytogeography.** **Rikli.**
Vierteljahrsschrift Naturforsch. Ges. Zürich 52 (1907): 1-155.
Botanische Reise Studien von der spanischen Mittelmeerküste, mit besonderer Berücksichtigung der Litoralsteppe. Von M. Rikli. *Illustrations.*
- Spain—Toledo.** **Calvert.**
Toledo: an historical and descriptive account of the "City of generations." By Albert F. Calvert. London: John Lane, 1907. Size 8 x 5, pp. xxiv. and 170. *Plans and Illustrations.* Price 3s. 6d. net. Presented by the Publisher. [See p. 212.]
- Spain—Volcanoes.** *American J. Sc.* 24 (1907): 217-242. **Washington.**
The Catalan volcanoes and their rocks. By Henry S. Washington. With *Sketch-map and Illustrations.*
- Sweden—Phytogeography.** **Birger.**
Die Vegetation einiger 1882-1886 entstandenen schwedischen Inseln. Von Selim Birger. (Sonderabdruck aus Engler's Botanischen Jahrbüchern, 38 Band, 3 Heft; 1906.) Leipzig. Size 9 x 6, pp. 211-232. *Map and Illustrations.*
See Monthly Record, January, 1908, p. 101.
- Switzerland—Lakes.** *Jahresber. G.-Ethnogr. Ges. Zürich* (1906-07): 105-127. **Früh.**
Wasserhöhen auf Schweizer-Seen. Von Prof. J. Früh. Size 9 x 6. With *Illustrations.* Also separate copy.
- Switzerland—Rhine.** ———
Régime des eaux en Suisse. Bassin du Rhin depuis ses sources jusqu'à l'embouchure de la Tamina. 4^e partie. Exécute et publié par le Bureau hydrométrique fédéral. Bern, 1907. Size 15 x 10, pp. xviii, 24, and 34. *Maps and Diagrams.*
- Turkey—Bibliography.** **Hasluck.**
Notes on MSS. in the British Museum relating to Levant geography and travel. By F. W. Hasluck. (Reprinted from the 'Annual of the British School at Athens,' No. xii., 1905-06.) Size 10 x 7½, pp. 196-216. *Facsimiles.*
Maps of Chios and Crete and a bird's-eye view of Constantinople are reproduced.
- United Kingdom—Berkshire.** **White.**
Memoirs of the Geological Survey: England and Wales. The geology of the country around Hungerford and Newbury. By H. Osborne White. London, 1907. Size 9½ x 6, pp. iv. and 150. *Sketch-map and Sections.*
- United Kingdom—Cambridgeshire.** **Fordham.**
Cambridgeshire Maps. Supplement, and additions and corrections, 1907. By H. No. IV.—APRIL, 1908. 2 I

G. Fordham. (From the Cambridge Antiquarian Society's Communications, vol. 11.) Size 11½ × 9, pp. 8. *Presented by the Author.*

United Kingdom—Cornwall.

Reid and Flett.

Memoirs of the Geological Survey: England and Wales. The Geology of the Land's End district. By Clement Reid and J. S. Flett. London, 1907. Size 9½ × 6, pp. viii. and 158. *Sketch-maps, Illustrations, and Sections.*

United Kingdom—Coventry. *Economic J.* 17 (1907): 345-357.

Leppington.

The evolution of an industrial town. By Miss C. H. d'E Leppington.

United Kingdom—England and Wales.

Smith.

The Itinerary of John Leland in or about the years 1535-1543, parts iv. and v. With an appendix of extracts from Leland's Collectanea. Edited by Lucy Toulmin Smith. London: George Bell & Sons, 1908. Size 9½ × 7, pp. viii. and 192. *Map. Price 12s. net. Presented by the Publishers.*

United Kingdom—Ireland. *Geol. Mag.*, V. 4 (1907): 501-506.

Reed.

Notes on some coastal features in Co. Waterford. II. Woodstown to Passage East. By F. R. Cowper Reed. *Section.*

United Kingdom—Rainfall.

Mill.

British Rainfall, 1906. On the Distribution of Rain in space and time over the British Isles during the year 1906. . . . By Hugh Robert Mill. London: E. Stanford, 1907. Size 9 × 5½, pp. 100 and 280. *Maps and Diagrams. Price 10s. Presented by Dr. R. H. Mill.*

The work of last year was greatly impeded by the illness and death of Dr. Mill's principal assistant. The report shows, however, that the operations of the organization are constantly being extended, and that their public value is meeting, if somewhat slowly, with recognition. There are special articles on the snowstorm of Christmas, 1906, and on the effects of wind on rain-gauges.

United Kingdom—Scotland. *Scottish G. Mag.* 23 (1907): 367-372. **Frew and Mort.**

The Southern Highlands from Glasgow. By John Frew and Frederick Mort. *With Sections.*

United Kingdom—Scotland. *Scottish G. Mag.* 23 (1907): 449-463.

Geikie.

Old Scottish Volcanoes. By Prof. James Geikie.

United Kingdom—Scotland. *Scottish G. Mag.* 23 (1907): 574-592.

Cash.

Manuscript maps by Pont, the Gordons, and Adair, in the Advocate's Library, Edinburgh. By C. G. Cash.

A former paper on this subject was summarized in the *Journal*, vol. 18, p. 614.

United Kingdom—Wales.

Strahan and others.

Memoirs of the Geological Survey: England and Wales. The geology of the South Wales coalfield. Part vii. The country around Ammanford. By A. Strahan, T. C. Cantrill, E. E. L. Dixon, and H. H. Thomas. Part viii. The country around Swansea. By A. Strahan. London, 1907. Size 9½ × 6, pp. (part vii.) viii. and 246; (part viii.) vi. and 170. *Maps, Sections, and Illustrations.*

ASIA.

Asia—Political.

Rouire.

Dr. Rouire. La rivalité Anglo-Russe au XIX^e siècle en Asie. Paris: A. Colin, 1908. Size 7½ × 4½, pp. viii. and 298. *Map. Price 8 fr. 50. Presented by the Publisher.*

Ceylon.

Corner.

Ceylon, the paradise of Adam; the record of seven years' residence in the island. By Caroline Corner. London: John Lane, 1908. Size 9 × 5½, pp. xxi. and 324. *Illustrations. Price 10s. 6d. net. Presented by the Publisher.*

China—Kiao-chow.

Weicker.

Kiautschou. das deutsche Schutzgebiet in Ostasien. Von Hans Weicker. Berlin: A. Schall, 1908. Size 9½ × 6½, pp. 240. *Plan and Illustrations. Price 8m.*

A useful outline of the geography and economic conditions of this German possession.

Eastern Asia.

Weale.

The coming struggle in Eastern Asia. By B. L. Putnam Weale. London: Macmillan & Co., 1908. Size 9 × 6, pp. xiv. and 656. *Maps and Diagrams. Price 12s. 6d. net. Presented by the Publishers.*

India—Historical.**Sainsbury.**

A calendar of the Court Minutes, etc., of the East India Company, 1635-1639. By Ethel Bruce Sainsbury; with an Introduction and Notes by William Foster. Oxford: Clarendon Press, 1907. Size 9 × 6, pp. xxxvi. and 396. Price 12s. 6d. net. Presented by the India Office.

Miss Sainsbury here continues her father's valuable 'Calendars of State Papers, East Indies,' the last instalment of which appeared in 1892. Mr. Foster's introduction supplies a lucid summary of the fortunes of the company during the period in question.

India—Trigonometrical Survey.

Account of the operations of the Great Trigonometrical Survey of India, vol. 18. Astronomical observations for latitude made during the period 1885 to 1905, and the deduced values of the deflections of the plumb-line. Prepared under the directions of Lt.-Col. S. G. Burrard. Dehra Dun, 1906. Size 12 × 9½, pp. x., 544, and 66. Sketch-map and Illustrations. Presented by the Survey of India.

Indo-China—Laos.**Reinach.**

L. de Reinach. Notes sur le Laos. Paris: Vuibert et Nony, 1906. Size 10 × 6½, pp. 124. Presented by the Author.

Malay Archipelago.**Schoeppel.**

Abh. k.k. (t. Ges. Wien 6 (1905-07) No. 2, pp. xii. and 302. Kommerzielles Handbuch von Niederländisch-Indien. Von Dr. F. A. Schoeppel. Maps and Illustrations.

Malay Archipelago—Celebes**Maengkom.**

Ta. K. Nederlandsch Aardrijksk. Genoots. 24 (1907): 855-871. Dagboek van een tocht uit Todjo naar Mori (Midden-Celebes), en terug naar het Poso-Meer (April 11-27, 1906) Door F. R. Maengkom. With Map.

Malay Archipelago—Ceram.**Sachse.**

Het eiland Seran en zijne bewoners. Door F. J. P. Sachse. Leyden: E. J. Brill, 1907. Size 10 × 6½, pp. iv. and 184. Maps, Sections, and Illustrations. Price 3 fl. 50. Presented by the Publisher.

A useful summary of our knowledge of the island.

Malay Archipelago—Java.**Jacobson.**

Ta. K. Nederlandsch Aardrijksk. Genoots. 24 (1907): 635-645. Eenige bijzonderheden omtrent het "Doodendal" op Java. Door E. Jacobson. Discusses the physical phenomena of the "Valley of Death."

Persia.*Petermanns M.* 53 (1907): 169-177, 205-214.**Stahl.**

Geologische Beobachtungen in Zentral- und Nordwest-Persien. Von A. F. Stahl. With Maps.

Philippine Archipelago. *Philippine J. Sc.* 2 (1907): 179-203.**Merrill.**

The ascent of Mount Halcon, Mindoro. By Elmer D. Merrill. See February number, p. 216.

Philippines—Luzon.*Philippine J. Sc.* 2 (1907): 207-231.**Eveland.**

Notes on the geology and geography of the Baguio mineral district. By A. J. Eveland. With Maps and Illustrations.

Russian Central Asia.*Z. Ges. F. Berlin* (1907): 429-440.**Rickmers.**

Die Sari-Kandal-Sagunaki-Gruppe im Duab von Turkestan. Von W. R. Rickmers. With Map and Illustrations.

Turkey—Arabia.**Doughty.**

Wanderings in Arabia. By Charles M. Doughty. Being an abridgment of 'Travels in Arabia Deserta,' arranged with introduction by Edward Garnett. 2 vols. London: Duckworth & Co., 1908. Size 9 × 6½, pp. (vol. 1) xx. and 310; (vol. 2) x. and 298. Map, Illustration, and Portrait. Price 16s. net. Presented by the Publishers.

AFRICA.**Algeria.****Wahl.**

L'Algérie. Par Maurice Wahl. Cinquième édition, mise à jour par Augustin Bernard. Paris: F. Alcan, 1908. Size 9 × 5½, pp. iv. and 454. Price 5 fr. Presented by the Publisher.

Cape Colony—Botany.**Marloth.***Mountain Club Annual*, [Cape Town] 11 (1907): 20-22.Notes on the flora of our mountain summits. By B. Marloth. *With Illustrations.***Cape Colony—Relief.***American J. Sc.* 24 (1907): 185-193.**Schwarz.**Plains in Cape Colony. By Prof. G. H. L. Schwarz. *With Illustrations. Also separate copy, presented by the Author.***Central Africa—Tanganyika.***P. Zoological S.* (1907): 643-656.**Günther.**Zoological results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunningham, 1904-1905. Report on *Limnocoila tanganicae*. By R. T. Günther. *With Illustrations.**Limnocoila* is the much-discussed Tanganyika jelly-fish.**Congo State.****Halot.**Vingt-cinq ans de civilisation au Congo. Par Alexandre Halot. Brussels: Falk Fils, 1908. Size $7\frac{1}{2} \times 5$, pp. xii. and 86. *Presented by the Publisher.***Congo State—Ethnology.****Overbergh.**Les Bangala (Etat Ind. du Congo). Sociologie descriptive, par Cyr. van Overbergh (Collection de monographies ethnographiques, 1.) Brussels: A. de Wit, 1907. Size $10 \times 6\frac{1}{2}$, pp. xvi. and 460. *Map. Presented by Captain S. F. Newcombe, R.E.***East Africa.***Jahresber. d. Ethnogr. Ges., Zürich* (1906-07): 75-104.**Luchsinger.**Von Schoa zum Stefanisee und zu den Borangalla. Von J. R. Luchsinger. *With Illustrations.***East Africa—Boundary.**Positions, azimuths, and lengths of sides of the Anglo-German boundary commission triangulation (1902-1906) from Zanzibar to Mount Ruwenzori. London: Topographical Section of the General Staff, 1907. Size $13 \times 8\frac{1}{2}$, 12 ll. *Maps.*See note in the *Journal* for July, 1907, p. 77.**East Africa—Relief.***G.Z.* 13 (1907): 478-505.**Uhlig.**Der sogenannte Grosse Ostafrikanische Graben zwischen Magad (Natron-See) und Luua ya Mueri (Manyara-See). Von Carl Uhlig. *Map and Illustrations.*

See February number, p. 216.

Egypt—Anthropology.**Rustafjaell.**Palaeolithic vessels of Egypt; or, the earliest handiwork of man. By Robert de Rustafjaell. London: Macmillan & Co., 1907. Size 9×6 , pp. 22. *Map and Illustrations. Price 2s. 6d. net. Presented by the Author.*

Describes recent archaeological finds in the western desert opposite Luxor.

Egypt—Climatology.**Keeling.**The climate of Abbassia, near Cairo. By B. F. E. Keeling. (Egypt: Survey Department Paper, No. 3.) Cairo, 1907. Size $10\frac{1}{2} \times 7$, pp. 62. *Plan and Diagrams.***Egypt—Geology.****Hume.**A preliminary report on the geology of the Eastern desert of Egypt between lat. 22° N. and 25° N. By W. F. Hume. (Survey Department Paper, No. 1.) Cairo, 1907. Size $10\frac{1}{2} \times 7$, pp. 72. *Maps and Illustrations.***Egypt—Language.****Thimm.**Egyptian self-taught (Arabic). By Captain C. A. Thimm. Third edition, revised by Major R. A. Marriott. London: E. Marlborough & Co., 1907. Size $7\frac{1}{2} \times 5$, pp. 80. *Price 2s. 6d. Presented by the Publishers.***French Sudan.***La G., B.S.G. Paris* 16 (1907). 225-235.**Desplagnes.**Les sources du Bakoy: régions aurifères soudanaises. Par le Lieut. Desplagnes. *Sketch-map.***French West Africa.****Chevans.**La mise en valeur de l'Afrique Occidentale Française. Par Henry Chevans. Paris: F. Alcan, 1907. Size $10 \times 6\frac{1}{2}$, pp. xii. and 280. *Price 6 fr.***German South-West Africa.****Pearson.**Some notes on a journey from Walvisch Bay to Windhuk. By H. H. W. Pearson. *With Map and Illustrations.*

Principally concerned with the plant-formations (see March number, p. 336).

German South-West Africa.**Rohrbach.**

Deutsche Kolonialwirtschaft. I. Band. Südwest-Afrika. Von Dr. Paul Rohrbach. Berlin: Schöneberg; Buchverlag der "Hilfe," 1907. Size 9 × 6, pp. viii. and 510. *Map and Illustrations.* Price 10s.

A systematic description of the physical geography of the territory, followed by a sketch of the progress made in its economic development.

German South-West Africa.**Leutwein.**

Elf Jahre Gouverneur in Deutsch-Südwestafrika. Von Theodor Leutwein. Berlin: E. S. Mittler u. S., 1908. Size 10½ × 7. pp. x. and 590. *Maps and Illustrations.* Price 11s.

Kamerun.*Deutsches Kolonialblatt* 18 (1907): 1088-1092.**Strümpell.**

Die Erkundung des Faro. (Bericht des Oberleutnants Strümpell. . .) *Sketch-map.*

See March number, p. 336.

Madagascar.*Ann. Hydrographiques* 28 (1907): 163-246. **Vanssay and others.**

Mission hydrographique de Madagascar. Rapports de MM. Vanssay, Courtier, Driencourt et Cot. *With Charts and Diagrams.*

Morocco—Coast. Renseign. Col., Com. Afrique française 17 (1907): 248-257. **Pobeguïn.**

Sur la côte ouest du Maroc; falaises, dunes, et barres. Par Pobeguïn. *With Plans and Sections.*

Portuguese West Africa—São Thome.**[Mendonça.]**

"The Bon Entrada plantations, S. Thomé, Portuguese West Africa. [By H. J. Monteiro de Mendonça.] Translated . . . by Lieut.-Colonel J. A. Wyllie. Edinburgh, etc.: Oliphant, Anderson, & Ferrier, 1907. Size 10 × 7½, pp. 64. *Illustrations.* Presented by the Author.

These plantations are claimed as a striking example of Portuguese humanitarian enterprise in her colonies.

Sahara. Renseignements Col., Com. Afrique française 17 (1907): 257-270. **Motyliniski.**

Voyages à Abulnessa et à la Koudia. Notes de Motyliniski. *With Map.*

On journeys across the Hoggar plateau.

Sahara.*La G., B.S.G. Paris* 15 (1907): 401-420**Chudeau.**

D'In Zize à In Azaoua. Par R. Chudeau. *Map.*

South Africa.**Passarge.**

Südafrika. Eine Landes-, Volks-, und Wirtschaftskunde, von Prof. Dr. Siegfried Passarge. Leipzig: Quelle u. Meyer, 1908. Size 9½ × 6½, pp. xii. and 356. *Maps, Diagrams, and Illustrations.* Presented by the Publishers.

South Africa—Climate*Globus* 92 (1907): 133-134**Passarge.**

Das Problem der Klimaänderung in Südafrika. Von Dr. Passarge. *With Diagram.*

The writer believes both in a temporary diminution of water-supply due to variations of rain-fall, and in a secular desiccation.

South Africa—Kalahari**Passarge**

Die Buschmänner der Kalahari. Von Prof. Dr. S. Passarge. Berlin: D. Reimer, 1907. Size 10 × 6½, pp. 144. *Illustrations.* Price 3m. Presented by the Publisher.

Sudan, French.*La G., B.S.G. Paris* 15 (1907): 321-336.**Chudeau.**

L'Aïr et la région de Zinder. Par R. Chudeau. *Map.*

Sudan—Language.**Harris.**

Hausa stories and riddles, with notes on the language, and a concise Hausa dictionary. By Hermann G. Harris. Size 7½ × 4½, pp. xvi., 112, and 34. A concise Hausa dictionary. First edition, 1908. By the same. Size 7 × 4½, pp. 34. Weston-super-Mare, 1908. Prices 5s. and 2s.

A few extra copies have been received for distribution.

Togo.*Globus* 92 (1907): 245-250, 265-269.**Smend.**

Eine Reise durch die Nordostecke von Togo. Von Smend. *Illustrations.*

Tristan da Cunha.

Tristan da Cunha. Further correspondence relating to the island of Tristan da Cunha. London: Wyman & Sons, 1907. Size 13 × 8½, pp. iv. and 64.

Refers to the suggested removal of the inhabitants, the visit of the ship *Greyhound*, and the decision of the people to remain.

Uganda.—Geology.**Roscati.**

A. Roscati. Nell' Uganda e nella catena del Ruwenzori. Relazione preliminare sulle osservazioni geologiche fatte durante la spedizione di S. A. R. il Duca degli Abruzzi nell' anno 1906. (Estratto dal *Bollettino della Società Geologica Italiana*, vol. 28 (1907), Fasc. II.) Roma, 1907. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 127-158.

West Africa.**Delafoisse.**

Les frontières de la Côte d'Ivoire, de la Côte d'Or, et du Soudan. Par M. Delafoisse. Paris: Masson et Cie., 1908. Size 9×6 , pp. xii. and 256. *Map and Illustrations.* Price 6 fr. Presented by the Publishers.

Account of the operations for the delimitation of the frontier between the Gold and Ivory coasts, with notes on the country and people.

NORTH AMERICA.**Canada—Tides.****Dawson.**

Variation in the leading features of the tide in different regions. By W. Bell Dawson. (Reprinted from the *Journal of the Royal Astronomical Society of Canada*, July—August, 1907.) Toronto, 1907. Size $9\frac{1}{2} \times 6$, pp. 213-227.

Mexico—Lower California. B. American G.S. 39 (1907): 544-554.**North.**

The uncharted sierra of San Pedro Mártir. By Arthur Walbridge North. *Map.*

Mexico—Popocatepetl and Ixtaccihuatl. Appalachia 11 (1907): 197-211.**Gilchrist.**

Climbs on Popocatepetl and Ixtaccihuatl. By Charles A. Gilchrist. *With Sketch-map and Illustrations.*

Mexico—Tehuantepec. Z. Ges. F. Berlin (1907): 321-333, 361-373.**Zahn.**

Der Isthmus von Tehuantepec. Von Dr. Gustav W. v. Zahn. *Map, Plans, and Illustrations.*

United States—Blue Ridge Mountains. J. Franklin I. 164 (1907): 161-175.**Waddell.**

Southern Appalachian streams. By Charles C. Waddell. *With Illustrations.*

United States—California. Alpina Americana, No. 1 (1907): pp. 16.**Le Conte.**

The high Sierra of California. By Prof. Joseph N. Le Conte. *With Map and Illustrations.*

United States—Climatology**Henry.**

Climatology of the United States. By Prof. Alfred Judson Henry. (U.S. Weather Bureau, Bulletin Q.) Washington, 1906. Size $11\frac{1}{2} \times 9$, pp. 1612. *Maps. Presented by the U.S. Weather Bureau.*

United States—Connecticut. B. American G.S. 39 (1907): 513-544.**Genthe.**

Valley towns of Connecticut. By Martha Krug Genthe. *Sketch-maps, Plans, and Diagrams.*

United States—East Coast**Harper.**

A midsummer journey through the coastal plain of the Carolinas and Virginia. By Roland M. Harper. (From the *Bulletin of the Torrey Botanical Club*, vol. 34, 1907.) Size 9×6 , pp. 351-377.

Especial attention is paid to the plant-formations.

United States—Michigan**Jefferson.**

Lateral erosion on some Michigan rivers. By Mark Jefferson. (From the *Bulletin of the Geological Society of America*, vol. 18.) New York, 1907. Size $10 \times 6\frac{1}{2}$, pp. 333-350. *Sketch-maps and Illustration.*

See March number, p. 339.

United States—Nevada, etc. U.S. Geol. Surv., B. 308 (1907): pp. 218**Ball.**

A geologic reconnaissance in south-western Nevada and eastern California. By Sidney E. Ball. *With Maps, Illustrations, and Sections.*

United States—Virginia. B.G.S. Philadelphia 5 (1907): 1-60.**Surface.**

Geography of Virginia. By G. T. Surface. *Map.*

CENTRAL AND SOUTH AMERICA.**Central America****Pector.**

Les richesses de l'Amérique Centrale: Guatemala, Honduras, Salvador, Nicaragua, Costa-Rica. Par Désiré Pector. Paris: E. Guilmoto, [not dated, 1908?]. Size $9 \times 5\frac{1}{2}$, pp. xvi. and 864. *Map. Price 7.50 fr. Presented by the Author.*

- Panama—Canal.** *P. Section Soc., K.A.W. Amsterdam* 9 (1906): 849-873. **Lely.**
 Velocities of the current in an open Panama canal. By Dr. C. Lely. *Map, Section, and Diagrams.*

Dr. Lely concludes that the velocity of the current due to tide in an open canal would be no obstruction to navigation.

- Peru.** **Walle.**
 Le Pérou économique. Par Paul Walle. Paris: E. Guilmoto, [not dated, 1908?] Size 9 x 5½, pp. xvi. and 388. *Map and Illustrations.* Price 9 fr. *Presented by the Publisher.*

- South America—Population.** **Jefferson.**
 The distribution of people in South America. By Prof. Mark Jefferson. (Reprinted from *Bulletin of the Geographical Society of Philadelphia*, July, 1907.) Size 9½ x 7, pp. 12. *Maps.*

- Venezuela—Cartography.** **Jahn.**
 Contribuciones al a geografía física de Venezuela. I. Observaciones al Plano Militar de la Republica. Par Alfredo Jahn. Caracas, 1907. Size 9 x 6, pp. 18.

- Venezuela—Ethnology.** **Tavera-Acosta.**
 En el Sur (dialectos indígenas de Venezuela) Por B. Tavera-Acosta. Ciudad-Bolívar, 1907. Size 10 x 7, pp. 414 *Illustrations.* *Presented by the Author.*

AUSTRALASIA AND PACIFIC ISLANDS.

- New Guinea—Dutch.** **Wichmann.**
 Nova Guinea. Résultats de l'expédition scientifique néerlandaise à la Nouvelle-Guinée en 1903, sous les auspices de Arthur Wichmann. Vol. 3, *Ethnography and Anthropology*, by G. A. J. Van der Sande. Leyden: late E. J. Brill, 1907. Size 13 x 10, pp. 390. *Map and Illustrations.* Price 50 fl., or, to subscribers to the whole series, 40 fl. *Purchased.*

- Pacific—German Possessions.** **Parkinson.**
 Dreissig Jahre in der Südsee: Land und Leute, Sitten und Gebräuche im Bismarckarchipel und auf den deutschen Salomoinseeln. Von R. Parkinson. Herausgegeben von Dr. B. Ankermann. Stuttgart. Strecker & Schröder, 1907. Size 9½ x 6½, pp. xxii. and 876. *Maps and Illustrations.* Price 10m. *Presented by the Publishers.* [To be reviewed.]

- South Australia—Northern Territory** **Searcy.**
 In Australian Tropics. By Alfred Searcy. London: K. Paul & Co., 1907. Size 9 x 6, pp. xxiv. and 374. *Map and Illustrations* Price 10s. 6d. net.

- Western Australia—Geology.** **Maitland.**
W. Australia, Geological Surv. B. No. 26 (1907): 37-66.
 Recent advances in the knowledge of the geology of Western Australia. (Presidential address to section C of the Australian Association, January 8, 1907.) By A. Gibb Maitland.

POLAR REGIONS.

- Antarctic—Scottish Expedition.** **Bruce.**
 Scottish National Antarctic Expedition. Report on the scientific results of the voyage of the S.Y. *Scotia*, during the years 1902, 1903, and 1904, under the leadership of William S. Bruce. Vol. 2, *Physics*. By R. C. Mossman, Charles Schree, and Sir George H. Darwin. Edinburgh: Scottish Oceanographical Laboratory, 1907. Size 12½ x 10, pp. vi. and 324 *Maps, Diagrams, and Illustrations.* Price 21s. [To be reviewed.]
- Spitsbergen.** *La G., B.S.G. Paris* 15 (1907): 421-432. **Isachsen.**
 La découverte du Spitsberg par les Normands. Par G. Isachsen.

MATHEMATICAL GEOGRAPHY.

- Cartography—Projections.** **Duchesne.**
 Les projections cartographiques Par Ch. Duchesne. Brussels, 1907. Size 9½ x 6½, pp. x. and 214. *Diagrams.* *Presented by the Author.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geological History.

Arlt.

Die Entwicklung der Kontinente und ihrer Lebewelt. Ein Beitrag zur vergleichenden Erdgeschichte. Von Dr. Theodor Arlt. Leipzig: W. Engelmann, 1907. Size 10×7 , pp. xx. and 730. *Maps. Price 20m. Presented by the Publisher.* [To be reviewed.]

Geomorphology—Erosion. *La G., B.S.G. Paris 15* (1907): 337-344.

Fleury.

Le chaudron latéral: forme particulière de l'érosion par les eaux courantes. Par Ernest Fleury. *Diagrams and Illustrations.*

Geophysics.

Clark.

The polarity of matter: an introduction to physics, showing that electricity, magnetism, chemical affinity, cohesion, and gravitation have one common origin. By Alex. Clark. London: Gall & Inglis, [1907]. Size 8×5 , pp. viii. and 134. *Diagrams. Price 3s. 6d. net. Presented by the Publishers.*

An attempt to prove that "the ultimate particles of matter pull each other by their extremities, like magnets, and not by their centres."

Geophysics. *Beiträge Geophysik 9* (1907): 41-77.

Schweydar.

Ein Beitrag zur Bestimmung der Starrheitskoeffizienten der Erde. Von W. Schweydar.

Geophysics.

Hecker.

Beobachtungen an Horizontalpendeln über die Deformation des Erdkörpers unter dem Einfluss von Sonne und Mond. Von O. Hecker (*Veröffentlichung des K. Preussischen Geodätischen Institutes, Neue Folge, No. 32.*) Berlin, 1907. Size 10×7 , pp. iv. and 96. *Illustration and Diagrams.*

Geophysics. *Quarterly J. Geol. S. 63* (1907): 344-350.

Oldham.

The constitution of the Interior of the Earth, as revealed by Earthquakes. (Second communication.) Some new light on the origin of the Oceans. By Richard Dixon Oldham. *Also separate copy.*

See note in the Monthly Record for December, 1907, p. 666.

Geophysics. *M.V.E. Dresden* (1907): 58-75.

Reibisch.

Ein Gestaltungsprinzip der Erde. III. Von Paul Reibisch.

Hydrology.

Hoyt and Grover.

River discharge, prepared for the use of engineers and students by John C. Hoyt and Nathan C. Grover. New York (London: Chapman & Hall), 1907. Size 9×6 , pp. viii. and 138. *Diagrams and Illustrations. Price 8s. 6d.*

A useful guide to methods of observation, etc.

Ice. *P. and T.R.S. Canada 12* (1906): Sect. III, 65-109.

Barnes.

Anchor-ice formation from the standpoint of the radiation theory, together with some early memoirs on ground-ice. By Dr. Howard T. Barnes.

Kumatology.

Cornish.

On surface waves produced by sledges. By Dr. Vaughan Cornish. (From *Proceedings Dorset Natural History and Antiquarian Field Club*, vol. 28, 1907.) Dorchester, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 12. *Illustrations.*

Observations of wave-forms on a quarry road at Coniston.

Kumatology.

Cornish.

Progressive and stationary waves in rivers. By Dr. Vaughan Cornish. [Reprinted from *Engineering*.] (London, 1907.) Size $9\frac{1}{2} \times 7\frac{1}{2}$, pp. 16. *Illustrations.*

The progressive waves were discussed by Dr. Cornish in the *Journal* for January, 1907.

Meteorology—Tropics.

Hann.

Der tägliche Gang der Temperatur in der äusseren Tropenzone. B. Das indische und australische Tropengebiet. Von Julius Hann. Wien, 1907. Size $12\frac{1}{2} \times 9\frac{1}{2}$, pp. 94. *Presented by the Author.*

Oceanography—Baltic.

Finnländische hydrographische-biologische Untersuchungen, No. 1. Hydrographische Untersuchungen im nördlichen Teile der Ostsee, im Bottnischen und Finnischen Meerbusen, in den Jahren 1898-1904. Helsinki (Leipzig: W.

Engelmann), 1907. Size $18 \times 9\frac{1}{2}$, pp. 46 and 144. Price 8m. Presented by the Publisher.

Oceanography—North Sea.

Wind and others.

P. Section Sc., K.A.W. Amsterdam 9 (1906): 566-573.

Current measurements at various depths in the North Sea. By Prof. C. H. Wind, Lieut. A. F. H. Balhuysen, and Dr. W. E. Ringer. With Diagrams.

Oceanography—Salinity.

Knudsen.

Conseil Perm. Explor. de la Mer; Publications de Circonstance, No. 38 (1907): pp. 10. Salzgehaltbestimmungen des Oberflächenwassers als Hilfsmittel bei Positionsbestimmungen an Bord. Von Martin Knudsen. With Map.

Physical Geography.

Dryer.

Lessons in physical geography. By Charles R. Dryer. New York. (London: G. Philip & Son), [not dated, 1907]. Size $7\frac{1}{2} \times 5$, pp. 430 and xxxii. Maps, Sections, Illustrations, etc. Price 6s net. Presented by the Publishers.

A reprint (with a few slight modifications and the addition of 32 pp. of supplementary matter) of Prof. Dryer's excellent text-book, reviewed in the *Journal*, vol. 19, p. 629.

Phytogeography—Plant-dispersal.

Birger.

Ueber den Einfluss des Meerwassers auf die Keimfähigkeit der Samen. Von Selim Birger. (Souderabdruck aus den "Beiheften zum Botanischen Centralblatt," Bd. 21 (1907): Abt. I. Heft 3.) Dresden. Size $9\frac{1}{2} \times 6$, pp. 263-280.

Phytogeography—Plant-dispersal.

Birger.

Ueber endozoische Samenverbreitung durch Vögel. Von Selim Birger. (Saertryck ur 'Svensk Botanisk Tidskrift,' 1907, Bd. 1.) Stockholm, 1907. Size $9\frac{1}{2} \times 6$, pp. 32.

Seismology.

J.T. Victoria I. 39 (1907): 43-60.

Upham.

The San Francisco and Valparaiso earthquakes and their causes. By Warren Upham. Map.

Seismology.

Oddone.

Publications du Bureau Central de l'Association Internationale de Sismologie, Série B. Les tremblements de terre ressentis pendant l'année 1904. Par Emilio Oddone. Strassburg, 1907. Size $11 \times 7\frac{1}{2}$, pp. xii. and 362. Presented by the Association through Major L. Darwin.

Terrestrial Magnetism. *National G. Mag.* 18 (1907): 601-611.

Bauer.

The work in the Pacific Ocean of the magnetic survey yacht *Gulilee*. By C. A. Bauer. With Illustrations. Also separate copy.

See note in the December number, p. 664, and ante, p. 448.

Volcanoes.

Le globe; Mém. S.G. Genève 46 (1907): 1-16.

Brun.

Le volcanisme. Par Albert Brun.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Economic Geography.

B. American G.S. 39 (1907): 472-481.

Smith.

Economic geography and its relation to economic theory and higher education. By J. Russell Smith.

Historical—Early Map.

B.S.G. Italiana, iv. 8 (1907): 1114-1121.

Crino.

Notizia sopra una Carta da Navigare di Visconte Maggiolo che si conserva nella Biblioteca Federiciana di Fano. Del Prof. Sebastiano Crino. Map.

On a hitherto undescribed chart of Maggiolo, formerly in the possession of Cav. Luigi Masetti (see January number, p. 110).

Historical—Maps.

Longhena.

Atlanti e carte nautiche del secolo XIV. al XVII. conservati nella biblioteca e nell'archivio di Parma. Note di Mario Longhena [Parma, 1907.] Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 46. Facsimile.

The most important item is the famous Pizigani map of 1367.

Historical—Maps.

McClymont.

Problematical features in maps designed by Mercator and Desceliers. By James Roxburgh McClymont. [Hobart], 1907. Size $9\frac{1}{2} \times 6$, pp. 10.

The writer recurs to the strange idea (first put forward by him some years ago) that

the unknown South-land of early maps is a misplaced, and reversed, representation of South America.

Statistics.

Biot.

Statistique annuelle de géographie comparée, 1907. Par Jean Biot. Paris, 1907.

Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 32.

Deals with the population, industries, and commerce of the countries of the world, with especial reference to France.

BIOGRAPHY.

Bacon.

Bacon.

The record of an aéronaut: being the Life of John M. Bacon. By his daughter, Gertrude Bacon. London: John Long, 1907. Size $9 \times 5\frac{1}{2}$, pp. 358. *Portraits and Illustrations*. Price 16s. net. Presented by the Publisher.

Grey.

Henderson.

Sir George Grey, pioneer of Empire in Southern lands. By Geo. C. Henderson. London: J. M. Dent & Co., 1907. Size $9 \times 6\frac{1}{2}$, pp. xxiv. and 316. *Maps and Illustrations*. Price 12s. 6d.

Hudson.

Bacon.

Henry Hudson: his times and his voyages. By Edgar Mayhew Bacon. New York & London: G. P. Putnam's Sons, 1907. Size 8×5 , pp. xii. and 378. *Facsimile Maps and Illustrations*. Price 6s.

The author supplies a readable account of Hudson's career, treated as that of a man of energy and action. He makes no claim to throw light on doubtful or disputed points relating to the geographical discoveries.

Macartney.

Robbins.

Our first ambassador to China. An account of the life of George, Earl of Macartney, with extracts from his letters, and the narrative of his experiences in China, as told by himself (1787-1806). By Helen H. Robbins. London: John Murray, 1908. Size 9×6 , pp. xx. and 480. *Portraits and Illustrations*. Presented by the Publishers. Price 16s. net.

Tipu Tib.

Brode.

Tipu Tib: the story of his career in Central Africa. Narrated from his own accounts by Dr. Heinrich Brode; with a preface by Sir Charles Elliot. London: E. Arnold, 1907. Size $9 \times 5\frac{1}{2}$, pp. xx. and 254. *Map and Portrait*. Price 10s. 6d. net.

Translation of the German original.

GENERAL.

Bibliography.

Gribaudo.

Inventario dei manoscritti geografici della R. Biblioteca Palatina di Parma. [Del Prof. Pietro Gribaudo.] Parma, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 24.

Disease—Sleeping Sickness.

Miscellaneous, No. 4, 1907. Proceedings of the First International Conference on the Sleeping Sickness, held at London in June, 1907. London, 1907. Size $13 \times 8\frac{1}{2}$, pp. 62. Price 6d.

Educational.

Emerson and Moore.

Geography through the stereoscope: Teacher's manual (pp. 152) and Student's stereoscopic field guide (pp. xxii. and 376). By Philip Emerson and William Charles Moore. New York, etc.: Underwood & Underwood, [1907]. Size $7\frac{1}{2} \times 4\frac{1}{2}$. *Plans*. Presented by Mr. D. W. Freshfield.

Deals with a method of geographical teaching which seems capable of useful developments.

Educational—Cartography.

Rothaug.

Die Grundprinzipien der Wiener Schule in der Neueren Schulkartographie. Vortrag . . . von Joh. Georg Rothaug. (Separatabdruck a.d. 30. Jahrgang des Pädagogischen Jahrbuches.) Vienna: G. Freytag & Berndt, 1908. Size 9×6 , pp. 20. Presented by the Publishers.

Europe and Africa—Historical.

Marshall.

Through Europe with Napoleon. By H. E. Marshall. London. T. C. & E. C. Jack, [1908]. Size 7×5 , pp. x. and 214. *Maps and Illustrations*. Price 1s. 6d. Presented by the Publishers.

Written with a view to teaching geography by means of historical associations.

Geography. *Scottish G. Mag.* 28 (1907); 337-346. **Fowler.**
Address to the Australasian Association for the Advancement of Science, Adelaide meeting, 1907. By J. W. Fowler.

Deals with the recent progress of geography, and in particular urges the importance of a scientific investigation, by the Australian Commonwealth, of the Indian Ocean to the west and south-west of Australia.

Photography. **Wellscome.**
Wellscome's Photographic exposure record and diary, 1908. London, etc.: Burroughs Wellscome & Co., [1907] Size $4\frac{1}{2} \times 3$, pp. 272. *Illustrations.* Price 1s. *Presented by the Publishers.*

Among the new features in this edition are tables for calculating exposures in night-work.

The World. **Grosvenor.**
Scenes from every land: a collection of 250 illustrations from the *National Geographic Magazine*, picturing the people, natural phenomena, and animal life in all parts of the world. Edited by Gilbert H. Grosvenor. Washington, D.C., 1907. Size 10×7 , pp. 224. *Map and Illustrations.* Price \$2.50. *Presented by the National Geographic Society*

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Austria.

Adrian, Braumüller, and Rothaug.

Karte der Bezirke Stadt und Land Salzburg und Hallein. Bearbeitet von K. Adrian und J. G. Rothaug. Karte der Umgebung von Klagenfurt. Scale 1:150,000 or 1 inch to 2.4 stat. miles. Vienna: G. Freytag & Berndt, [1908]. *Presented by the Publisher.*

These are two specimens of the stereoscopic system of colour-tinting for representing relief, which was referred to in the *Geographical Journal* for June last (p. 680). Superimposed upon the usual vertical hachuring, somewhat lightly printed, is a series of tints in order of the spectrum, ranging from dull blue-green, by which the low-lying lands are indicated, through pale yellowish-green and yellow, to red-brown, and culminating in a vivid brownish-red. The high summits, being nearer the eye—which is, of course, supposed to be vertically over the map—stand out prominently, and appear to be nearer, while the lowlands, which are furthest from the eye, being a dull blue-green, appear to recede into the distance. The effect is similar to that of a painting in which reddish-brown is used for the foreground to give the effect of nearness, and bluish-green for the distance. If any fault can be found with this system of colouring as exhibited on these maps, it is that the blue-green is too green, and that the distinction between this tint and the next is too abrupt. There appears to be too great a contrast between the low-lying lands and the medium heights.

England and Wales.

Ordnance Survey.

Sheets published by the Director-General of the Ordnance Survey, Southampton, from February 1 to 29, 1908.

2 miles to 1 inch:—

Large-sheet series, printed in colours, folded in cover or flat in sheets, 13, 14, 15, 18, 36. Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.

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In outline, 98, 142, 155, 294. 1s. each (engraved).

With hills in brown or black, 142, 277. 1s. each (engraved).

Large-sheet series, printed in colours, folded in cover or flat in sheets, 10, 11, 111, 121, 143. Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.

6-inch—County Maps:—

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(First Revision), 9 N.W., S.E., 12 S.E., 17 N.E., S.E., 19 S.W., S.E., 20 N.W., N.E., S.E., 21 N.W., N.E., S.E., 70 S.E. **Norfolk** (First Revision), 51 S.W., S.E., 62 N.E., S.E., 63 N.W., 64 N.W., N.E., S.E., 65 S.W., 75 N.W., N.E., S.E., 76 N.W., N.E., S.W., S.E., 77 N.W., N.E., S.W., 88 N.W., N.E., 89 N.W. **Pembrokeshire** (First Revision), 23 N.E., 28 S.E., 36 N.W., 41 S.E. **Yorkshire** (First Revision of 1891 Survey), 247 S.W., 248 N.W., 250 S.E., 262 N.E. 1s. each.

25-inch—County Maps:—

Cornwall (First Revision), I.VI. 15; I.VIa. 16; LXII. 4, 12, 14; LXIII. 1, 5, 6, 7, 8, 9; I.XIV. 9; I.XVII. 3, 6, 7, 8, 9, 10, 11, 12; LXVIII. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; LXIX. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; LXX. 1, 5, 9; LXXVI. 3, 16. **Kent** (Second Revision), XII 8, 11, 12, 15, 16; XIII 7, 9, 10, 11, 12, 13, 14, 15, 16; XX. 4, 8, XXI. 1, 3, 4, 8, 11, 12, 15; XXII. 1, 5, 9, 13; XXXII. 8, 12; XXXIII. 2, 3, 6, 9, 14; XLIV. 2, 3, 7, 14; LII 10, 12, 14, 16; LIV. 2, 3, 5, 9, 13; LXIII. 2, 3, 4, 6, 8, 12, 14; LXIV. 1; LXXIX. 3, 4; LXXX. 1, 15; LXXXI. 13; LXXXIII. 3, 8, 12, 16; LXXXIV. 1, 5, 9, 13. 3s. each. LXXXIII. 6, 15. 1s. 6d. each. **Lancashire** (First Revision of 1891 Survey), CVIII 2, 5. **Pembrokeshire** (First Revision), XIV. 14; XX. 1, 3, 5, 7; XXI. 1; XXXI. 6, 7, (8 and 12), 10, 11, (12 and 8), 16; XXXIV 10; XXXVII (3 and 2, 6, 7). **Yorkshire** (First Revision of 1891 Survey), CCXIV. 12, 15, 16. CCXV. 5, 6, 7, 8, 9, 11, 12, 13, 14; CCXX. 2, 7, 9, 11, 12, 13, 15, 16; CCXXXII. 4, 6; CCXXXIV. 2, 7, 10, 11, 13, 15, 16. 3s. each.

(E. Stanford, London Agent.)

England and Wales.

Geological Survey.

4 miles to 1 inch:—

New Series, printed in colours. Solid edition. Sheet 22, Plymouth, Exeter, Lyme Regis, etc. *Price* 2s. 6d.

6-inch—Maps—Uncoloured:—

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(E. Stanford, London Agent)

Europe—Central.

K. u. K. Militargeographisches Institut, Vienna.

Generalkarte von Mitteleuropa. Scale 1:200,000 or 1 inch to 3.2 stat. miles. Sheets: Rodosto, Xanthi. Vienna: K. u. K. Militargeographisches Institut, [1907].

Europe—Central.

K. u. K. Militargeographisches Institut, Vienna.

Uebersichtskarte von Mittel-Europa. Scale 1:750,000 or 1 inch to 11.8 stat. miles. Sheet J-7, Bucuresti (Bukarest). Vienna: K. u. K. Militargeographisches Institut, [1908].

Europe—Central.

K. u. K. Militargeographisches Institut, Vienna.

Hypsometrische Uebersichtskarte von Mittel-Europa. Scale 1:750,000 or 1 inch to 11.8 stat. miles. Sheet J 7, Bucuresti (Bukarest). Vienna: K. u. K. Militargeographisches Institut, [1908].

France.

Ministre de l'Intérieur, Paris.

Carte de la France dressée par ordre du Ministre de l'Intérieur. Scale 1:100,000 or 1 inch to 1.6 stat. mile. Sheets. xi 20, Doué; xiv. 17, Vendôme; xiv. 25, Limoges; xv. 28, Brive; xvii. 19, Aubigny; xviii. 33, St. Affrique; xix 11, Fismes; xx.-21, Autun; xx.-32, Alais; xxiv.-19, Riez; xxv.-13, Château-Salins; xxv. 21, Pontarlier. New Editions. Paris: Ministère de l'Intérieur, Service Vicinal, 1907. *Price* 0.80 fr. each sheet.

Italy.

Sauer.

Strade Ferrate Italiane in esercizio, in costruzione ed in progetto con indicazione a colori delle diverse Province e di tutte le stazioni. Compilata da Federico Sauer. Scale 1:800,000 or 1 inch to 13.6 stat. miles. Four sheets. Bologna: Sauer & Barignazzi, [1908].

Italy—Rome.

Istituto Cartografico Italiano.

Pianta di Roma redatta su quella pubblicata per il Comune di Roma dall' Istituto Cartografico Italiano. Edizione 1908, riveduta e corretta. Scale 1:8000 or 7.9 inches to 1 stat. mile. Rome: G. Scotti & Co., 1908.

ASIA.

China—Mongolia.

Obrutschew.

Uebersichtskarte der Gebirge Djur, Urkaschar, Kodjur und Ssemistai der

chinesischen Deungarei. Nach den Aufnahmen von M. A. Ussow, Mitglied der Expedition, 1906, persönlichen Beobachtungen und russischen Karten entworfen von Prof. W. A. Obrutschew. Scale 1:1,000,000 or 1 inch to 15.8 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1908, Tafel 4. Gotha: Justus Perthes, 1908. *Presented by the Publisher.*

India.

Johnston.

India: Political Divisions; Railways and Canals, Density of Population; Industries; Agriculture; Forest Lands under Government Control; Minerals; Annual Rainfall and Temperature. Scale 1: 5,900,000 or 1 inch to 93 stat. miles. Edinburgh and London: W. & A. K. Johnston, [1908]. *Price £1.4s. the set. Presented by the Publisher.*

A series of clearly drawn maps of India, printed in colours, and arranged so that they could be conveniently bound in atlas form, or hung on a wall of a small classroom. Only a few important names are given.

India—North-West Frontier.

Topographical Section, General Staff.

North-Western Trans-Frontier. Scale 1: 63,360 or 1 inch to 1 stat. mile. London: Topographical Section, General Staff, War Office, [1908]. *Price 1s. 6d. Presented by the Director of Military Operations*

AFRICA.**Egypt.**

Survey Department, Cairo.

Topographical map of Fayum Province. Scale 1:10,000 or 6.3 inches to 1 stat. mile. Sheets: N.E. 8-3; S.W. 17-8, 18-7, 18-8, 19-6, 19-7, 19-8, 20-1, 20-3, 20-4, 20-5, 20-6, 20-7, 20-8, 21-6, 21-9, 21-10, 22-3, 23-9; S.E. 14-1. Topographical map of Qaliniya Province. Scale 1:10,000 or 6.3 inches to 1 stat. mile. Sheets N.E. 6-8, 8-3. Topographical map of Aswan Province. Scale 1:10,000 or 6.3 inches to 1 stat. mile. Sheet S.E. 147-38. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Egypt—Cairo.

Huber.

Plan du Caire dressé à la base de documents officiels par R. Huber. Scale 1: 5000 or 12.7 inches to 1 stat. mile. 4 sheets. Cairo: F. Diemer, [1908].

A large and well-executed plan of Cairo, printed in colours by Dr. C. Wolf & Sons, Munich, on four sheets, each of which measures 33 inches by 27 inches. Upon the south-west sheet is printed an index to street names, administrative offices, consulates and other public buildings and institutions.

German East Africa.

Sprigade and Moisel.

Karte von Deutsch-Ostafrika. Bearbeitet von P. Sprigade und M. Moisel. Scale 1: 300,000 or 1 inch to 4.7 stat. miles. Sheet C1, Udjiji. Berlin: Dietrich Reimer (Ernst Vohsen), 1906. *Presented by the Publisher.*

Gold Coast.

Guggisberg.

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1: 125,000 or 1 inch to 1.9 stat. mile. Sheets: 72—Q-III, Tarkwa, 73—M-I, Prampram. Edinburgh and London: W. & A. K. Johnston, 1908. *Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.*

AMERICA.**Brazil—S. Paulo.**

Comissão Geographica e Geologica de S. Paulo.

Topographical map of the State of Sao Paulo. Scale 1: 100,000 or 1 inch to 1.5 stat. mile. Sheets: Guaraby; Jacarehy. Sao Paulo: Comissão Geographica e Geologica, 1907. *Presented by the Geographical and Geological Commission of the State of Sao Paulo.*

Two additional sheets of the map of S. Paulo, reviewed in the *Geographical Journal* for December last. As with the other sheets, contour-lines are shown in brown at intervals of 25 metres, and water in blue. These are preliminary issues only. In general appearance the sheets resemble those of the U.S. Geological and Topographical Survey, and like these, will form the basis upon which the geological features will be represented.

Canada.

Department of the Interior, Ottawa.

Sectional map of Canada. Scale 1: 190,080 or 1 inch to 3 stat. miles. Sheets: 264, Braseau, revised to Nov. 25, 1907. 266, Ribstone Creek, revised to Nov. 11,

1907; 416, *La Biche*, revised to Nov. 15, 1907. Ottawa: Department of the Interior, Topographical Surveys Branch, 1907. *Presented by the Director, Department of the Interior, Ottawa.*

Chile.

Oficina de Limites, Santiago.

Mapa jeográfico de la Puna de Atacama. Scale 1:1,000,000 or 1 inch to 15·8 stat. miles. Santiago: Oficina de Limites, 1905.

Chile.

Oficina de Limites, Santiago.

Mapa de la region austral de Chile. Provincias de Llanquihue, Chiloe I., Territorio de Magallanes. Scale 1:1,000,000 or 1 inch to 15·8 stat. miles. Santiago: Oficina de Limites, 1908.

South America.

Mackinder

Stanford's new orographical map of South America, compiled under the direction of H. J. Mackinder, M.A. Scale 1:6,000,000 or 1 inch to 94 stat. miles. 4 sheets. London: Edward Stanford, 1904. *Price 16s. Presented by the Publisher.*

This is an addition to the excellent series of orographically coloured wall maps now being published by Mr. Stanford, under the direction of Mr. H. J. Mackinder, M.A. The land relief and ocean depths are clearly indicated by colour tinting and contours, the former being well shown by shades of brown only, and not by different colours, and the latter in blue. Under the brown tinting the general form of the mountain ranges is lightly indicated by vertical hachures. The land contours and the figures indicating heights are shown in blue as well as those on the water, which seems rather a mistake, as blue naturally suggests water. Names are lightly printed in grey, so that the general effect of the relief is not spoiled, as is often the case with such maps.

GENERAL.

German Colonies.

Sprigade and Moisel.

Grosser Deutscher Kolonialatlas. Bearbeitet von Paul Sprigade und Max Moisel. Herausgegeben vom Reichs-Kolonialamt. Lieferung 6. Togo. Berlin: Dietrich Reimer (Ernst Vohsen), [1908]. *Presented by the Publisher.*

This is the northern sheet of a good general map of Togo, which will be published in two sheets in the German Colonial Atlas. The map has been compiled from the route traverses of explorers, adjusted to the more exact surveys of the boundary commissions. A complete index to place-names accompanies the sheet.

World.

Harmsworth.

Harmsworth Atlas and Gazetteer. Parts 35 and 36. London: The Amalgamated Press, Limited, [1908]. *Price 7d. each part.*

These parts contain a collection of maps and diagrams of the world's commerce.

World.

Romer.

E. Romer. Atlas Geograficzny. Lemberg and Warsaw, 1908. *Presented by D. W. Freshfield, Esq.*

Considering the price, about 1s. 6d., this little Polish physical and political atlas is a creditable production. The maps, of which there are ten sheets, are well drawn, and by a system of carefully printed and well registering colour-tinting, show land-relief and ocean depths. Perhaps a better selection of tints could have been made for the land, and certainly the glaringly bright red of the greatest heights might have been avoided, and some tint chosen more in character with the others. Inset maps, showing political divisions, are given on smaller scales on each sheet. Although small, the maps are so carefully drawn that it has been possible to show a considerable amount of detail.

World.

Rothaug.

Johr. Georg Rothaug's wiener Schul-Globus. Kleine Ausgabe. Scale 1:60,000,000 or 1 inch to 946·9 stat. miles. Vienna: G. Freytag & Berndt, [1908]. *Presented by the Publisher.*

The special feature of this little school-globe is the arrangement for showing the seasons and the lengths of the day and night in all latitudes for different times of the year. This is accomplished by enclosing half of the globe in a movable convex cover, painted black. Slots are cut in this at the polar regions, through which the metal axis of the globe can pass, and which allow the cover to be moved in the plane of the meridian through an angle of 23½°. A clamp-screw is attached, so that the black cover can be clamped to the brass meridian at any position it may be desired, and so show the duration of daylight at any special season. Although this arrangement

has decidedly new features, somewhat similar designs are not uncommon, but, owing to their elaborate and complicated nature, such devices often tend to confuse rather than instruct. However, a great point in favour of this globe is the simplicity of its construction. In fact, apart from the special case, or hemispherical envelope, referred to, it is merely a globe 8½-in. mounted on a single upright metal pedestal, 9 inches in height, held by a semicircular brass meridian, through the extremities of which passes the metal axis about which the globe revolves. The land relief on the globe is shown by the stereoscopic system of colour tinting.

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published by the Hydrographic Department, Admiralty, during January, 1908. Presented by the Hydrographer, Admiralty.

New Chart

No. Inches.
3683 m = 5·9 England, east coast :—Medway river :—Approaches to Sheerness,
 8.

Chart Cancelled.

No. 328 North American lakes: Port Collier.

Charts that have received Important Corrections.

Index charts:—A. to V. No. 3346, Germany:—Jade and Weser rivers. 2842a, Baltic sea:—Western sheet. 2842b, Baltic sea:—Eastern sheet. 2826, Gulf of Finland:—Approaches to Viborg. 3479, Gulf of Finland:—Channels leading to Viborg. 2279, Gulf of Finland:—St. Petersburg bay. 2215, Gulf of Finland:—Kronstadt, north and south channels. 2239, Gulf of Finland:—The bay and city of St. Petersburg. 2059, North Atlantic ocean. 2058, North Atlantic route chart showing variation curves. 2866, North America, east coast:—St. John's to Halifax. 2870, North America, east coast:—Halifax to the Delaware. 2456, United States, east coast:—Nantucket sound and western approaches. 2892, United States, east coast:—Narragansett bay. 2479, United States, east coast:—Black Rock and Bridgeport harbours. 2471, United States, east coast:—New London harbour. 2857, United States, east coast:—Potomac river. 456, Jamaica:—Port Royal and Kingston harbour. 1098, Gulf of Mexico:—Lower Matamucum cay to Boca Grande cay. 1499, Alaska:—Cross sound to Kadiak island. 3313, Alaska:—Yakutat bay, Controller bay. 1500, Alaska:—Kadiak island to Segum island. 100a, Gulf of Aden:—Ras Galwéni to Ras Hafún. 2722, Siam:—Koh kut to Bay island. 2725, Siam:—Koh Tron and channels leading to anchorages off Kamput. 1742, Canton river:—Sheet IV. 2400, China, east coast:—The bar and approaches to the river Min. 166, China, east coast:—Pagoda anchorage and approaches. 2847, China, north coast:—Hai yung tau, including Thornton haven. 1316, Korea:—Cape Duroch to Linden point. 2432, Manchuria:—Tumen Ula to Strelok bay.

Indian Ocean and Red Sea.

Meteorological Office.

Monthly meteorological chart of the Indian Ocean north of 15° S. lat. and Red Sea, March, 1908. London: Meteorological Office, 1908. Price 6d. each. Presented by the Meteorological Office.

North Atlantic.

U.S. Hydrographic Office.

Pilot chart of the North Atlantic Ocean, March, 1908. Washington: U.S. Hydrographic Office, 1908. Presented by the U.S. Hydrographic Office.

North Atlantic and Mediterranean.

Meteorological Office.

Monthly-meteorological chart of the North Atlantic and Mediterranean, March, 1908. London: Meteorological Office, 1908. Price 6d. each. Presented by the Meteorological Office.

North Pacific.

U.S. Hydrographic Office.

Pilot chart of the North Pacific Ocean, March, 1908. Washington: U.S. Hydrographic Office, 1908. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Angola.

Lewis.

Forty-two photographs of Northern Angola, taken by Rev. Thomas Lewis. *Presented by Rev. Thomas Lewis.*

Many of these photographs were shown as lantern slides when the Rev. T. Lewis read his paper to this Society on February 24 last. They were taken during his extensive travels in Northern Angola, during which districts practically unknown before were visited. The following are the titles:—

(1) Kibokolo; (2 and 3) B.M.S., Kibokolo; (4) Garden of B.M.S., Kibokolo; (5) Mr. Lewis' bungalow, Kibokolo; (6) Interior of school decorated for Christmas feast, B.M.S., Kibokolo; (7) Dispensary at Kibokolo; (8) The Portuguese Government House, San Salvador; (9) Catholic Church, San Salvador; (10) B.M.S. Mission House, San Salvador; (11) Waterfall at San Salvador; (12) Mr. Pimmoock and group of carriers, Zombo; (13) A Zombo waif; (14) Zombo natives; (15) Group of Zombo carriers; (16) A station pet; (17) Tiger lily; (18) Upper Nkisi river; (19) View showing bracken; (20) Juvenile group; (21) Graves of the kings of Kongo; (22) On the Mbidizi river; (23) Educated native's house; (24) Hammock travelling; (25) Temporary buildings, B.M.S., Mabaya; (26 and 27) Noki; (28) Noki, from passing steamer; (29) Mbidizi, above the confluence with the Lufunde river; (30) View on Lufunde river; (31) Old church used as warehouse at Mbembe; (32) View in Mbamba; (33) Houses in Mbamba; (34) School chapel, Kibokolo; (35) Buying native food, Kibokolo; (36) Forging the Mbidizi river; (37) A step in civilization; (38) Mules in Zombo; (39) A trading establishment, Makela do Zombo; (40) A guardian fetish; (41) Fetish carving.

Bolivia and Peru.

Fawcett.

Seventy photographs of Bolivia and Peru, taken by Major P. H. Fawcett, R.G.A.

Presented by Major P. H. Fawcett, R.G.A.

These form a valuable addition to the Society's collection. They were taken during the last two years by Major Fawcett whilst travelling in eastern parts of Bolivia and the upper waters of the Amazon, in connection with his duties as boundary surveyor for the Bolivian Government. Many of the views are unique, and of a decidedly geographical interest.

(1) Batelon at the Cachuela Riberon, Rio Madeira; (2) View of country on the Lima-Oroyo railway; (3) Bridge on Lima-Oroyo railway; (4) Mollendo; (5 and 6) Country near Arequipa; (7) Arequipa; (8) Street in Arequipa; (9-11) Views on Lake Titicaca; (12-14) La Paz; (15) The Alto Planicie; (16) Ruins of Tiahuanaco; (17) Street in Sorata; (18) View of Illampu from Sorata; (19) View of Illampu and Sorata from Sorata village; (20) Street in Sorata; (21) Clouds at sunrise in the mountains, Tola Pampa; (22) Arrieros on the Mapiri trail; (23) Picking rubber; (24) Curing rubber; (25) San Antonio baracca near Mapiri; (26) View of Mapiri; (27) Callapos at Mapiri; (28) On the Mapiri river; (29) Callapos on the Mapiri river; (30) View on Beni above Burenabaque; (31) Retama rapid on the Mapiri; (32) Going up-stream, Mapiri river; (33 and 34) On the Beni above Burenabaque; (35) Burenabaque; (36) Porvenir; (37) Group at Porvenir; (38) The Tahuamanu at Porvenir, looking west; (39) The Aquery at Bahia, looking east; (40) View in Bahia; (41) Officials at Bahia; (42) Bahia, looking west; (43) Compound of Government building, Bahia; (44) Merchant's house, Bahia; (45) Last baracca of the Aquery, Yorongas; (46) On the upper Aquery, Cascada de Aviapas; (47) Camp, upper Aquery; (48) Cascada Montes, upper Aquery; (49) On the upper Aquery; (50) Poso de Fossiles, Yaverija; (51) Xapury; (52 and 53) Gavion; (54) Campo Central; (55 and 56) Forest near Campo Central; (57) Brazilian children at Gavion; (58) On the road to Campo Central; (59) Campo Central; (60) Building boats at Santa Rosa; (61) Santa Rosa; (62) Colonel Placado de Castro, first and last president of the Acre; (63) Camp in the Abuna; (64) Brazilian rubber packers in the Abuna; (65) Interior of a rubber centio; (66) A rubber centio; (67) Cachuela Riberon, Rio Madeira; (68-70) Pulling a batelon across land past a rapid, Rio Madeira.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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THE VOLCANOES OF GUATEMALA.*

By Dr. TEMPEST ANDERSON.

I SPENT nine months, including the winter of 1906-7, among the volcanoes of Mexico, Guatemala, and the West Indies. The first and last named groups are comparatively well known, while those of Guatemala, though equally, if not more important, have, owing to their remote and inaccessible position, scarcely attracted the attention they deserve from English geologists, though they have been described by a French commission under Dollfus and Montserrat† in 1868, and more recently by Prof. Karl Sapper,‡ of Tübingen. They consist of a row of giant cones averaging 10,000 to 12,000 feet in height, roughly parallel with the Pacific coast. As viewed from the deck of a Pacific mail steamer they present a most imposing appearance, for though really at a distance of 50 miles from the coast, their whole height is visible at once, as no other range of mountains intervenes, the coast being a belt composed of Quarternary beds which only rise into low foothills. These foothills, the Costa, are covered with coffee plantations, from which the well-known Guatemala coffee is largely produced.

None of these volcanoes is habitually in eruption, like Izalco in Salvador, or Stromboli in the Lipari islands; on the contrary, their

* Royal Geographical Society, January 13, 1908. Map, p. 588.

† 'Voyage Géologique dans les Républiques de Guatemala et de Salvador.' Par MM. Dollfus et E de Montserrat. Paris. Imprimerie Imperiale. 1868.

‡ 'Mittelamerikanische Reisen und Studien.' Dr Karl Sapper. Vieweg. Braunschweig. 1902. 'In den Vulkangebieten Mittelamerikas und Westindiens.' Dr. Karl Sapper. Stuttgart: E. Nagels. 1905. Also several smaller articles, of which the following especially deals with this district, and has been freely quoted: 'Die Vulkanischen Ereignisse in Mittelamerika,' in Jahre 1902. Karl Sapper. 'Neuen Jahrbuch für Mineralogie, etc.,' 1904, Bd. I. Stuttgart: Nagels.

eruptions usually take place only after intervals of many years, even centuries, during which the volcano is quiescent and may appear extinct. Then a terrific explosive eruption occurs in which discharges of ash and fragmentary material predominate, though the outflow of lava is not unknown, and the whole country for miles round is devastated. The cones are in most cases separated by an interval from those adjacent in the chain, and, where the vent has shown a tendency to shift and form parasitic or subsidiary cones, the new opening has usually been nearer to the Pacific ocean. An apparent exception to this rule mentioned by Dollfus and Montserrat was the case of Santa Maria, 11,480 feet, and Cerro Quemado. The former is an old volcano, and was supposed to be extinct. The latter, adjacent but further inland, is more recent, and had been active in 1785, when it poured out some large flows of andesitic lava. In 1902, after a severe earthquake which almost destroyed the adjacent city of Quezaltenango, Santa Maria opened out an enormous new crater, nearer the sea than its old one, and of course than that of Cerro Quemado, and is thus no longer an exception to the general rule.

This eruption is so important in relation to those of the Soufrière in St. Vincent, and Montagne Pelée in Martinique, that the associated phenomena deserve special mention.

On January 18, 1902, there was a severe earthquake.

On February 26 an unusual tidal wave was observed along the coast of Salvador and part of Guatemala.

On April 18 a very severe earthquake almost destroyed the town of Quezaltenango, and caused subsidences at Ooós.

On May 7 and 8, the great eruptions of St. Vincent and Martinique, on the other side of the Caribbean Sea, burst into full activity, after premonitory signs lasting a few days.

On May 10, Izalco in Salvador, to the south of Guatemala, resumed activity after 15 months' quiescence.

On June 25, Masaya, in Nicaragua, after forty-three years' inactivity, resumed slight activity, which continued for several weeks, and the neighbouring crater of Santiago showed similar signs, as did also Momotombo, which had been at rest for many years. Colima, in Mexico, above 700 miles distant, also showed signs of awakening energy. These phenomena culminated in the great outbreak of Santa Maria on October 23 and 24, and following days. I and my colleague, Dr. Flett, have elsewhere fully discussed the general sequence of these volcanic phenomena.* The details of the above must now be discussed separately.

* Anderson and Flett. 'On the Eruptions of the Soufrière, etc.' Part I. *Phil. Trans.*, Series A, vol. 200, 1903, pp. 532. Parts II. and III., 1908, will contain the later history, the petrology, and a bibliography.

The Earthquake of January 18, 1902.

Guatemala has always been considered a district particularly subject to earthquakes, especially at the changes of the seasons in April, May, and October, November, but they had been less frequent than usual for some years before 1902.

On January 18 a severe shock was felt widely over the Republic. San Martin, a village near Quezaltenango, had some houses thrown down; and at Ocoés, on the Pacific coast, three parallel ridges, sloping gently towards the sea, but steep towards the land, were formed in the sand. List, quoted by Sapper,* writes, "Just as at any moment one may see a wave break on the shore, so the volcanic breaker remained modelled in the sand of Ocoés." The ridges were in general parallel to the coast-line, and could be traced for a distance of about an English mile. The earth-waves passed through a coffee shed, and some of the steel pillars had sunk 2 feet. The waves on the pier are described as having a length of 25 to 30 metres, and a depth of 25 to 30 cms. As showing the strength of the shock, it is mentioned that two locomotives, weighing 20 tons each, were moved 6 feet in the direction of the earth push. Similar appearances were observed on the Mexican coast near San Benito. Sapper considers the earthquake tectonic in character, i.e. caused by readjustments of the Earth's crust, in this case probably a slip somewhere under the Pacific.

The earthquakes of April 18 were considered by List at Ocoés to be of the same nature as that of January 18, i.e. tectonic. In that of April 18, the sinking of the sand continued further inland than in January. Sapper does not consider it clear whether it was a general sinking of the coast or merely a local sinking of the sand inland due to the shaking. At Quezaltenango the shock was especially violent. Mr. Walter S. Ascoli,† who was on the spot, relates that while he was quietly reading about 8.20 p.m., without the slightest warning or premonitory tremor, the Earth began to sway violently, and the ornaments in the room all lost their balance and fell to the floor. This oscillation continued for twenty seconds, then suddenly the motion became vertical and much more violent. Later on the shocks seemed to come from all directions. Loud "retumbos" (underground noises) were heard. Scarcely a single house or building in the town remained habitable, and those on the slopes of the Cerro Quemado, consisting chiefly of *adobe* (i.e. dried mud), were entirely destroyed. As showing the violence of the shocks, the church of San Sebastian, which was built soon after the Spanish

* Sapper, 'Neues Jahrbuch,' *ut sup.*, p. 49.

† In a letter to Dr. Anderson. Much information has also been obtained from Mr. A. H. Gehrke, of Rösing Bros., London and Guatemala; Don Carlos Moesly, of Helvetia; Herr John Lisser, of Retalhuleu; besides Sapper's works; to all of whom my thanks are due.

occupation, and had resisted all the earthquakes since that time, was completely ruined. Mr. Ascoli considers that the deaths in Quetzaltenango really exceeded one thousand, though reported at a much smaller number. This earthquake was very widespread. It was felt from the city of Mexico, and even San Francisco, as far as Salvador, especially along the Pacific slope, the coffee zone at the foot of the volcanic range having suffered severely, but it was curiously local. It was probably most severe at Quetzaltenango and San Pedro and along the high lands to Sololá, but some villages within a few miles of the former town escaped almost entirely, and so did Totonicapam, only a few miles north of Sololá. It was noticed that brick houses suffered more damage than those built of stone, and these again more than those with wooden frames; while the native ranchos, built of poles covered with thatch, bound together with bands made of creepers, suffered scarcely at all. Many landslips were traced to the shock.

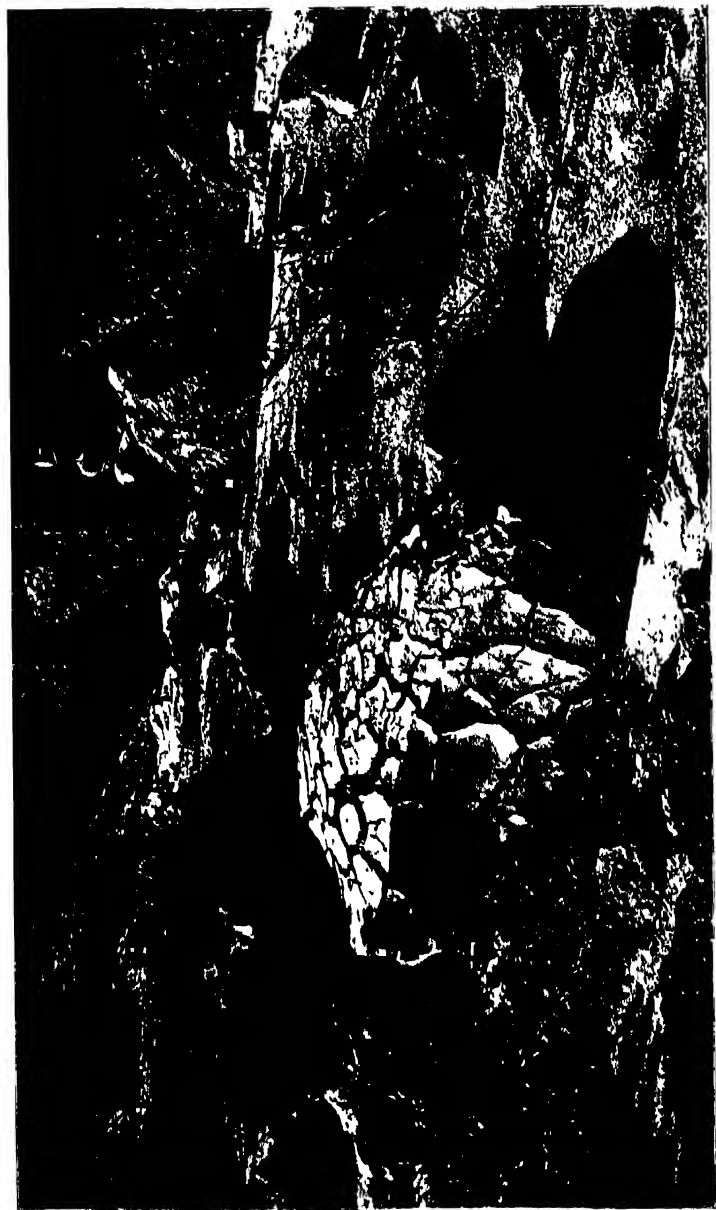
After April 18 a series of small earthquakes occurred, and on September 23, another severe one. Rockstroh, who visited the damaged districts after the occurrence,* considers the three earthquakes of January 18, April 18, and September 23 all tectonic; while List, who observed them all personally at Ocós, considers the last of quite a different character to the others. The smaller ones were probably volcanic, and connected with the approaching outbreak of Santa María. Some were more local in their distribution, and more severe towards the Salvador frontier. They may have been connected with the renewed activity of Izalco.

The tidal wave of February 26, 1902, is reported by Aurelio Arias, director of the Meteorological Observatory of San Salvador,† to have extended along the coast of Salvador about 120 kilometres, especially at Barra del Paz, and to have reached as far north as Acajutla. At about 7 p.m. three waves, of which the first was the smallest, swept on the land and caused great damage. Their height is not mentioned, but about 100 persons were killed at the village of Santiago, and 85 at Barra del Paz. Loud "retumbos" (subterranean noises) were heard, and thought to proceed from under the sea.

The Cerro Quemado, also known as the volcano of Quetzaltenango, is near the town of that name, and as viewed from the Plaza, seems actually to overhang it. Though it had a small and perhaps doubtful outbreak in 1891, its last eruption of importance was in 1785, and while no accurate records are preserved, it is probable that, at any rate, some of the lava-streams which form such a conspicuous feature of the mountain were formed in that year. As mentioned above, most of the eruptions of these Guatemalan volcanoes have been of the explosive type,

* Report to the Government, quoted by Sapper, p. 49.

† *El Siglo*, San Salvador, 20, No. 3, 184 (June 20, 1902).



Temple & Anderson Photo

BREAD-CRUST BOMB IN THE CRATER OF THE CERRO QUEMADO.

Suam Electric Engraving Co., Ltd

and characterized by the emission of large quantities of fragmentary ejecta, ash, lapilli, and pumice, while often no lava is poured out. The last considerable eruption of Cerro Quemado was an exception, for not only were enormous quantities of lava discharged, but the form of the streams was peculiar. They consolidated on quite deep slopes, and often terminated in almost vertical walls, perhaps 100 feet or more in height. The lava appears to have been quite pasty at the time of its discharge, and to have quickly consolidated into a crust, which, as the lava under it continued to flow, broke up into blocks of varying but generally considerable size, and these have been pushed and rolled forward till they have formed a sort of wall, and have so helped to prevent the further progress of the lava. This, of course, is not unusual, but I have seldom seen the final slopes so steep, though another similar case occurs at Colima, in Mexico. As confirming the theory that the lava must have been pasty and almost consolidated at the time of its emission, I found in the crater of the mountain several well-marked bread-crust bombs, which are considered as characteristic of the Vulcanian type of eruption, *i.e.* where the explosions have taken place from among lava more or less consolidated. The idea is that the mass of lava before its ejection had cooled sufficiently for its surface to have consolidated, while the interior still remained pasty or even liquid, and that when it was thrown suddenly into the air, and the outside pressure relieved, the vapours, which in different degree always exist in the lava, became separated and formed vesicles, and so swelled the mass and caused the crust to crack. One of these bread-crust bombs is shown in Plate I., and is indistinguishable from others I have seen on Vulcano, after the typical Vulcanian eruption of 1888, and also on Colima, where they appeared to be associated with the above-mentioned lava-stream. The crater itself presents confirmatory appearances. It is a large hollow filled chiefly with blocks and slabs of well-consolidated lava with definitely broken edges, showing that they were quite solidified before they took their present position. It contains a few insignificant fumaroles, and some sparse pine trees are striving hard for a precarious existence. At the foot of the volcano are some hot springs at Almolonga, and at Zunil some small geysers.

The volcano of Santa Maria, as viewed from the slopes of the Cerro Quemado, from which it is only a few miles distant on the south, appears as a very regular cone (Plate II.). It is covered to the top on this, its north, side with vegetation, which appears to have been only partially destroyed by the great eruption of 1902. It was ascended in March, 1902, only a few months before this eruption, by Mr. Walter S. Ascoli, who found a small crater on the summit, consisting of an irregular, shallow, rocky depression some 120 feet in diameter. At the bottom the rocks were split up, leaving narrow clefts between them, from which, however, no steam or vapour escaped. The beds forming the mountain

dipped outwards in every direction in the manner usual in volcanic cones. The volcanoes mostly spring from a plateau about 5000 feet above sea-level, and Santa Maria is no exception, standing at the edge of the high land. The country to the north is all an elevated region, while to the south are the foothills, the "costa," which slope gradually down to the coastal plain. They are mostly formed of fragmentary volcanic materials, and are much cut up into steep, narrow ridges separated by deep valleys similar to those on the flanks of the West Indian volcanoes. These ridges were, before the eruption, the seat of coffee plantations, which were then devastated, and have only partially recovered. At the foot of the mountain was a comparatively flat piece of ground overlooking this system of valleys, which was somewhat less sloping than the surrounding parts, and had consequently been selected as a camping-ground by the engineers engaged in making a survey for a railway from the coast round the mountain to the town of Quezaltenango behind it. It was covered with a dense tropical growth like the rest of the mountain, from which it showed no special difference.

It was from this place that the eruption of October 24, 1902, broke out. Slight earthquakes were felt in the neighbourhood during the day, and about 5 p.m. a loud and increasing sound was heard in San Felipe, a neighbouring village. This sound appeared to come from the direction of the mountain. It was compared by some to the noise of a waterfall, by others to a gigantic boiler blowing off. The noise lasted half an hour. About this time dark clouds were noticed from Quezaltenango and elsewhere in the direction of the mountain. They were at first ascribed to a thunderstorm. Towards evening a slight sprinkling of sand occurred at Quezaltenango, which soon covered the landscape with white. The wind changed from south to east, and ashes began to fall at Helvetia, a coffee plantation 6 miles to the south-west. About 7 p.m. a glow began to appear, and lightning was noticed in the neighbourhood of the present crater, and roaring sounds were heard. About 8 p.m. the air had sufficiently cleared for an enormous black cloud to be visible to persons at a distance from the mountain. It was seamed with countless curved lines of red and green electric discharges; violent claps of thunder were noticed (but it is not mentioned at what distance they were best heard). About 1 a.m., October 25, stones began to fall at Sabina, a bathing establishment at the foot of the mountain towards the south-east. At 3 a.m. pumice-stones fell abundantly in Helvetia. They measured 15-25 centimetres, and weighed $\frac{1}{2}$ to $\frac{3}{4}$ lb. They were first cold, then hot, and later were mixed with stones of heavier material as big as the fist. Lapilli the size of peas fell at Quezaltenango, 10 miles north-north-east. The eruption increased in violence, and the whole district was enveloped in darkness. The maximum intensity was reached about 11 a.m. on Sunday the 25th, though it remained severe till nightfall. It was not



Tempest Anderson photo

until midday on the 26th that the air began to clear a little and the light to return. The eruption continued with varying severity for most of the week. Towards the end of the eruption, as is generally the case, outbursts of whitish steam began to preponderate over the dark ash-laden clouds. Don Carlos Moesly, of Helvetia, gave me a graphic description of how a building at Suiza, in which a large number of people had taken refuge, collapsed by the weight of ashes on the roof. With the assistance of a French machinist * and some natives he extricated twenty-two alive, but eighteen were left dead.

When all was clear again, it was seen that an entirely new crater had been formed at the base of the mountain, and that the whole surrounding country was devastated and deeply covered with ashes. This crater is oval in form, with the long diameter parallel to the coast, and as far as my plane-table observations, which were made from the Finca Helvetia at a distance of about 6 miles, can be relied upon, this measures from $\frac{3}{4}$ to $\frac{7}{8}$ of a mile. The shorter diameter is not very much less, probably from $\frac{1}{2}$ to $\frac{5}{8}$ of a mile. The whole side of the mountain was blown away, exposing a section of several thousand feet in height, in which the dip of the strata mentioned above is very evident. Owing to the dip being with the slope, landslides almost constantly take place, and are gradually filling up the crater, though the latter is still apparently from 1000 to 1500 feet in depth. It has a lake at the bottom and two very active fumaroles, or perhaps rather hot springs, from which steam and hot water escape with a violence almost worthy of the name geyser. These fumaroles issue from the foot of the cliff, at a point where traces of a great radial crack in the mountain are visible. Observations on these points are, however, very difficult. Helvetia, my base, was fully 6 miles distant, and direct access was cut off by many impassable ravines. The ascent, as mentioned below, was only possible by making a long *détour* to the south-east *vid* Palmar, from which side ridges lead more or less in the desired direction. The crater was almost constantly full of a cloud of dust which drifted away before the wind, and looked very suggestive of commencing eruption, but careful examination showed that this was due solely to the falling stones, except an occasional puff of steam from the fumaroles, which now and then rose above the lip of the crater. When a view of the great cliff was occasionally obtained, I could see many beds of tuff and agglomerate, but could never be certain of any compact lava. The mode of origin seems a perfect example of that attributed by Sir Charles Lyell to the Val del Bove on Etna, and in order of magnitude it is enormously greater than that of the eruptions of the Soufrière and Montagne Pelée in the same year.

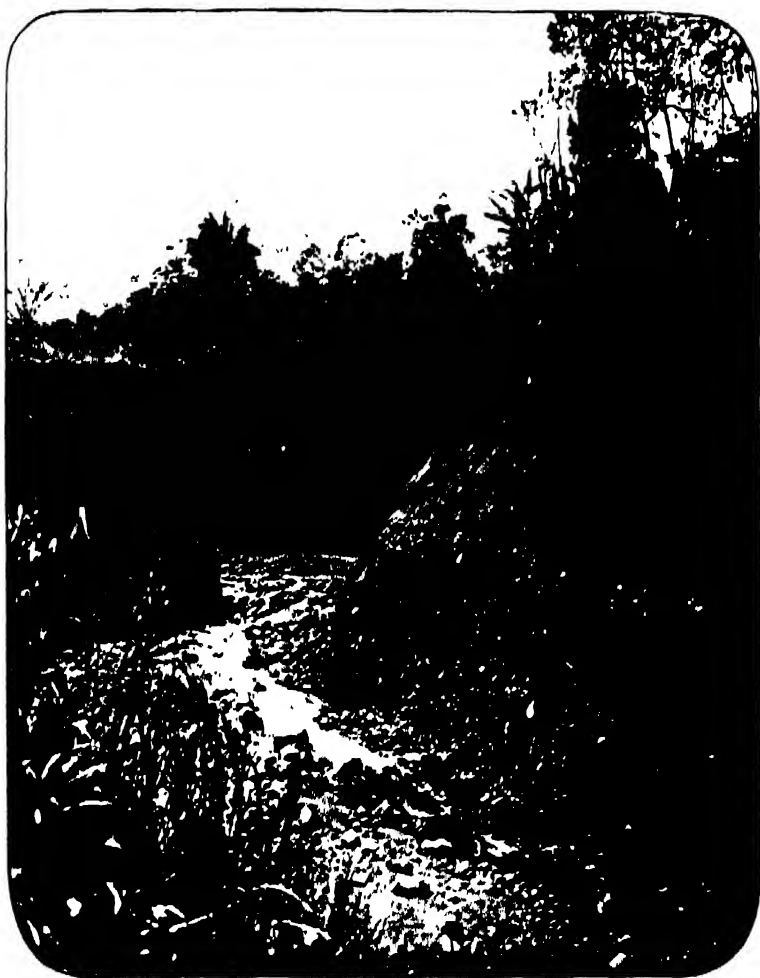
* The French machinist was the only man who stayed with Mr. Moesly all through the eruption, and he is still employed there at increased wages.

The eruption cloud rose to a great height. It was seen from the sea. The captain of one steamer* measured the height with a sextant, and recorded it as 17 to 18 miles. Another put it as much as 80, but this may be merely an estimate. The sounds accompanying the eruption were loud, and, as has been observed elsewhere, were heard even louder at distant places than close to the mountain. Thus at Guatemala city, the capital, the detonations were at times so strong that they were supposed to proceed from the neighbouring volcanoes.

There is no evidence of the occurrence of any incandescent avalanche or hot blast like those which occurred in St. Vincent and Martinique, but there are unconfirmed rumours of explosions having taken place in the hot ash, like those which occurred in the islands just mentioned, and which were there traced to the action of water on that material. The ashes measured later on were $7\frac{1}{2}$ English feet deep at Suiza, and $4\frac{1}{2}$ to 5 feet at Helvetia, the place to which the works were moved after the catastrophe. At Nil, more to the north-east, and nearer the mountain in the track of the main discharge of ashes, the depth was 10 to 12 feet. Still nearer the mountain the depths were much greater. At San Antonio the top of the chimney was all that remained uncovered, from which it is concluded that the deposit was about 14 metres in thickness. At the Baths of Sabina, near the foot of the mountain, the ashes were at least 80 feet thick, while nearer the crater the depth was not less than 100 feet, and may have been 200 feet in places. The ashes were carried widely over the district to the west and north-west, and even into remote parts of Mexico, such as Acapulco and Colima. Mr. Gehrke, a partner in a firm of coffee merchants, who had large interests in the crops which were destroyed, and who visited the district soon after the eruption and measured the depths of the deposit, estimates the total amount in the district as not less than twenty thousand million tons, without reckoning that carried away to a distance by the wind. Sapper mentions maps showing the distribution in Mexico as having been made by more than one observer, but states they only agree in broad general features. It will be remembered that "Krakatoa" sunsets were observed in Europe in the autumn of 1902 and were attributed to the West Indian eruption in the previous May. There was always a difficulty in understanding this late appearance, and there is now, I believe, no reasonable doubt that they were due to Santa Maria.

The ash deposits immediately after the eruption presented a pretty uniform surface, the old valleys, at any rate near the crater, having been in great measure, if not entirely, filled up. The surface was at first quite soft and incoherent, and difficult to walk on without sinking. Torrents of rain fell either at the time of or directly after the eruption, a large portion of which sank into and consolidated the new deposits,

* Captain Saunders, of the Pacific Mail S.S. *Newport*.



Tempest Anderson, photo.

Swan Electric Engraving Co., Ltd.

NEW GORGE OF RIVER NIMA AT PALMAR.

reducing the measured thickness at the same time. A large portion of the rain, however, ran off, producing a feather-pattern erosion, shown in some of the earlier photographs, like that noticed in St. Vincent and Martinique.* As in those islands also, the torrents of water and mud flowed in new courses independent of the old ones, which had been filled up, and formed new channels, in many cases cutting deep into the soil and subjacent beds which previously existed. Thus a deep and narrow ravine, about 80 or 100 feet deep and perhaps 100 or 120 feet wide, now exists to the east of, and not many yards from, the Plaza of Palmar. It has been cut out of the old tuff and agglomerate, and now conveys the water from the river Nima, which formerly ran in quite a different direction into the Samalá (see Plate III.). In other cases the floods carried away bridges and deepened the old ravines, and the mud brought down blocked up the river Ocosito near Ocos, and altered the configuration of the coast in that neighbourhood. All these changes strikingly recall similar ones in St. Vincent.†

When the surface of the ash deposits had become more consolidated, and before denudation had had time to produce much effect, access to the mountain was easy, but as the rain and atmospheric agencies did their work, deep gullies were formed, divided by narrow ridges. In the low grounds, where change had been less active, the ridges, at the time of my visit, were generally flat-topped, where the crust had protected the underlying, less-consolidated material. This often weathered into almost vertical walls, till another somewhat harder layer was reached, which formed a new shelf, the whole making a succession of steps, such as to remind one of the tops and keyboards of a succession of pianos placed end to end, along the tops of which it was not difficult to walk (see Plate IV.). Further up the mountain, where the process was further advanced, intermediate blocks had often been entirely washed away, and this necessitated constant ascents and descents, which were decidedly fatiguing. Further up again, as in Plate V., the whole top crust had generally been removed, and the ridges were often reduced to mere knife-edges, which were liable to give way and precipitate the traveller into the deep crevasse on either side. This plate, which is taken on the south-west of the mountain above Palmar and the site of the Baths of Sabina (from which direction the wind was blowing at the time of the eruption), exhibits well the comparative thinness of the ash on that side of the mountain, as shown by the dead tree-trunks, which still project through the ash. Nearer the crater the ash becomes much thicker and the barrancos deeper. This plate also exhibits the structure of the mountain, with the beds of tuff and agglomerate dipping conformably to the slope. This shows that they

* Anderson and Flett, part i. plate 28 ; Sapper, 'Ereignisse,' Taf. vii.

† Anderson and Flett, *loc. cit.* ; Anderson, *Geographical Journal*, March, 1908.

were deposited as ejecta from the old crater on the summit, and not from one in the position of the new crater. The thick beds of ash with their deep barrancos extended far beyond the left of the plate. All this presents a striking resemblance to the corresponding localities on the slopes of the Soufrière. On some of the ridges in the lower ground, as, for instance, in the coffee plantations, the resemblance is still more striking. Plate VI. is practically indistinguishable from a plate to appear in the Soufrière Report, Part II., and may be compared with Part I., Plate 35, which shows a similar place directly after the eruption. In each the ridge and slopes had been covered with a thin layer of ash. On the ridge this only received the rain which actually fell on it. This mostly sank in, and a firm crust was produced which offered considerable resistance to further change. On the slopes on each side the ash was exposed not only to the rain which fell directly on it, but also to the wash from the higher parts, and in many places had been carried away, and thus exposed the soil, on which vegetation is returning in many cases from the old roots.

The loss of life is supposed to have been very great, but, unfortunately, no accurate statistics are available, as the victims were chiefly Indians who had come down from their villages in the mountains into the coffee zone to assist at the harvest. Still the opinion of those on the spot puts it at possibly two or three thousand.

The lake of Atitlan is not only one of the most interesting, but also one of the most beautiful places in the world, and its interest is much increased by the survival of several villages of Indians who retain many of their primitive customs, and still wear curious costumes. The lake is, roughly speaking, nearly circular, or would be so if it were not for several big volcanoes on its south bank, beyond which the plateau slopes rapidly down to the coastal plain. Its longest diameter is about 20 miles. On the east, north, and west, where there are no volcanoes, the slopes are usually very steep, though in a sufficiently advanced state of denudation to be a good deal cut up by valleys of rivers and brooks which flow into the lake. It has generally been supposed that the basin of this is only a continuation and union of these valleys, and that after they had been excavated, the volcanoes broke out on their beds and formed the lakes by blocking the exit for the water. This supposition is certainly plausible. The north shore is formed of volcanic tuffs and conglomerates of recent geological age, and sufficiently denuded to agree with either this or with the hypothesis that the lake itself is a crater, while the dip of their beds is so complicated that its evidence is not conclusive either way. I noticed, however, that the west shore of the lake extended in a well-marked, almost precipitous bank right round to the south of the volcanoes of San Pedro and Atitlan, and was perfectly separate from the slopes of the former, and to a large extent from those of the latter. I visited it, and found it composed of beds of tuff all dipping to the south



Tempest Anderson, photo.

A RIDGE IN THE NEW ASH ON SANTA MADIA

Suam Electric Engraving Co. Ltd



Tempest Anderson photo



Tempest Anderson, photo

A RIDGE COVERED WITH CONSOLIDATED ASH, HELVETIA.

Suwan Electric Engineering Co.



Tempest Anderson photo

TROPICAL FOREST ON THE SLOPES OF ATITLAN.

Swam Electric Engraving Co., Ltd.

towards the Pacific and away from the lake. Thus both the naked-eye form of the ridge, and the geological structure, suggest that it is the lip of an enormous crater, and that the volcanoes of San Pedro, Atitlan, and Toliman, giants as they are, are merely secondary cones thrown up on its floor. If that is so, this crater lake must certainly be one of the largest, if not the largest, in the world.

I made the ascent of Atitlan along with the proprietor of the steamer on the lake, with whom I was boarding, and a party of his friends. We started from San Lucas, at the east end of the lake, and rode first through cultivated fields, then through a woodland track, crossing one or two lava-beds exposed in the bed of a stream, till at a clearing we left the horses, which could be got no further, and we entered on foot the virgin forest which clothed the slopes of the mountain. We soon had to have a path cut, which rendered progress slow, but we pushed on as far as possible till nearly nightfall, when we camped under a sailcloth brought for the purpose. Plate VII. shows the view from our camp, which was naturally the most open spot we could find. The trees are covered with mosses and lichens, which in places depend in festoons, and with hanging roots which grow down from the branches till they reach the ground and take root on their own account. The Mozo has a machete in his hand, such as is used for cutting a path. The foliage overhead is so dense that the place is quite gloomy, even in broad daylight. The night was not particularly cold, but the ground was damp and disagreeable. We heard the cries of various animals in the night, but they did not come near us. Next morning we were up before daylight, and, without any special adventure, reached the top. The way for the last few hundred feet was over large, rather loose scoriæ, and the actual top was a sort of plain with a slight depression in it, which might be supposed to be the remains of a crater. The surface was a mass of small blocks of compact lava, with cracks from which vapours escaped here and there. The view was very striking. The whole Lake of Atitlan was at our feet, except where hidden by the volcanoes of Toliman and San Pedro. The crater ring surrounding the lake could be distinctly traced, while the whole volcanic range from Santa Maria or beyond, on the west, to Fuego, Acateango and Agua on the east, was distinctly visible. The coastal plain lay below us, and we got occasional glimpses of the ocean beyond, but soon the moisture condensed, as usual before midday, and instead of the Pacific we looked down on an ocean of clouds. I have seen this wonderful spectacle from many other heights, but never more grandly than on this occasion. On our descent, as we got to the level of the sea of clouds we had an opportunity of watching their formation. The warm moist air from the Pacific met the cold dry air from the plateau above the rim of the old crater of the lake, and the rolling, seething mass of cumulus clouds formed a mass never to be forgotten.

The volcanoes of Fuego, 13,120 feet, and Agua, 12,286 feet, are other members of the chain more to the east, and are near to the city of Antigua Guatemala, once the capital of Spanish America. Fuego has been repeatedly in eruption in historic times, the last date being 1880, but its outbreaks, which are of the explosive type, present no special features beyond their violence. It has a large and very deep crater open towards the Pacific, and this has such a characteristic aspect that it is of great value as a landmark, for even a glimpse of it, through a break in the clouds, cannot be mistaken, and gives the navigator a sure bearing. Agua presents a well-marked crater breached to a certain extent in the direction of a valley leading down to Antigua. It has not had an ordinary volcanic eruption during the historic period, but in 1541 a great flood of water descended the mountain and destroyed a still older capital, Ciudad Vieja, situated at its base. It has been supposed that the flood proceeded from the bursting of a lake in the crater. This, however, extends to a depth at least 50 feet below the old breach, and I could not see either a raised beach, or any other evidence of the crater having held a lake. On the whole, therefore, I am inclined to believe that the flood was really the result of a cloud-burst on the mountain and not a volcanic phenomenon at all. After this catastrophe the city of Antigua was built, and in its turn was destroyed by a violent earthquake in 1773, in consequence of which the present capital was built, and the seat of government was removed to it. The ruins of Antigua, including many churches overgrown with vegetation, are very picturesque and interesting.

Guatemala appears to have a great future before it. Up to the present time access to it has been almost entirely by steamer on the Pacific *viâ* Panama or San Francisco, in either case a most circuitous and expensive route; but now two new ways are in process of being opened—one through Mexico *viâ* the Tehuantepec railway across the isthmus of that name, at either end of which magnificent new harbours have been constructed at Coatzacoalcas and Salina Cruz; and the other by a new railway direct to the capital from Puerto Barrios, also a new port on the Atlantic seaboard, to which steamers already run from New Orleans direct.

My cordial thanks are due to Sir Edward Grey, of the Foreign Office, and Mr. Carden, the British Minister at Guatemala, for their good offices with the Guatemala Government, and to Señor Juan Barrios, Foreign Minister of Guatemala, who exerted himself most effectively on my behalf with various local authorities. I found these gentlemen uniformly courteous and obliging, and to their kind assistance in obtaining trustworthy guides, porters, and other facilities too numerous to mention, much of the success of my expedition was due. I wish also particularly to thank Mr. Walter G. Ascoli, F.R.G.S., of Manchester, Guatemala, and Quezaltenango, Mr. Gehrke, F.R.G.S., and Mr. Moesly,

of Finca Helvetia, as well as other planters too numerous to mention, for their kind assistance and hospitality. Their local knowledge in a country like this was simply invaluable.

Before the paper, the Chairman, Colonel CHURCH: It is with much regret that I have to announce that our President is unable to be present this evening owing to a slight illness. Our lecturer this evening is already known to you, and about four years ago he entertained us with his experiences, his studies, and his wonderful photographic plates of the volcanic eruptions in Martinique and Mont Pelée. I may mention that not only did he greatly distinguish himself by his analysis of those eruptions, but that he is also familiar with many parts of the world where he has done good work in the same direction, work always characterized by a thoroughness which is worthy of admiration. He has taken care to possess himself of everything in the shape of mechanical appliances known to photography, and consequently what he does is perfectly reliable. He was accompanied in his examination of Mont Pelée and Martinique by Dr. Flett, of the Geological Survey. The country from which he now returns with so much valuable information is one of the great volcanic centres of the world. I will now call upon Dr. Tempest Anderson to read his paper.

After the paper, Dr. FLETT: Listening to Dr. Anderson's descriptions to-night, and seeing on the screen the beautiful series of photographs of Guatemalan scenery and volcanoes, I could not help being struck very greatly with the similarity which exists between the volcanic phenomena in Guatemala and those with which Dr. Anderson and I became acquainted in the year 1902, when we had the opportunity of visiting together the volcanoes of the West Indies. There is some connection between the volcanoes of St. Vincent, Martinique, and those of Guatemala, because in May, 1902, when Montagne Pelée in Martinique and the Soufrière in St. Vincent burst into eruption, there were earthquakes in Guatemala; and six months later, while the volcanic activity was still going on in the West Indies, this great eruption took place of which Dr. Anderson has shown photographs to-night. One feature of the outbursts in both these districts was that the products were principally ashes, sand, and dust, so that the scenery of the Guatemalan volcano is very like that of the volcanoes in Martinique, where the whole surface of the ground was covered over with thick layers of ashes and sand.

Equally striking to us, perhaps, who are accustomed to temperate climates is the extraordinary rapidity with which these great masses of ashes are swept away from the bare surface of the ground in tropical climates. The photographs, for example, shown us to-night, when compared with the photographs taken in 1902 and 1903 by Prof. Karl Sapper, show that, vast as was the quantity of material ejected, the greater part of it has been swept away from the higher ground by the rivers, and transported to the sea. In the same way, in the West Indies, the larger part of the material which wrought devastation there was very soon removed, and with it part of the underlying soil, which had been, of course, left bare and unprotected by the destruction of the vegetation. I think you will agree with me that the year 1902 is one which will be marked with a red letter in the history of volcanic activity. In that year we had three volcanic outbursts of great magnitude: these were, the eruptions at Montagne Pelée, at the Soufrière in St. Vincent, and at Santa Maria in Guatemala. It is a curious fact that the greatest of these three in physical magnitude, namely, the Guatemalan eruption, is one which has been least known hitherto to English and American geologists, whereas the one which was least in point of mere magnitude has, on account of its fatal action on the town of

St. Pierre and the loss of nearly thirty thousand lives, and the extraordinary nature of the volcanic phenomena which it presented, become so famous as to be almost a household word to geologists. The service which Dr. Anderson has rendered in visiting Guatemala and bringing before us so careful an account of the volcanic phenomena in that quarter, is one which I am sure the scientific public in England will highly appreciate.

Mr. MAUDSLAY: I can add very little to what Dr. Anderson has told us. I certainly do know these volcanoes very well, having ascended the Volcan de Fuego once and Agua three times. I quite agree with what Dr. Anderson has said about the destruction of the first city of Guatemala. It must have been a cloudburst, and not a volcanic eruption, that destroyed it. We must remember that Guatemala—the city of Guatemala, as it was called even in those times—was a very, very small affair indeed. The wife of the conqueror Pedro de Alvarado lost her life in that cloudburst, and no doubt it made a great impression upon the people in the country, but I have gone carefully through the accounts of it, and it is quite clear that it had rained very hard for three or four days, and that it was a wave of mud from the slope of the mountain that overwhelmed that small town. The few inhabitants took refuge in the chapels, where they were most of them smothered. You have seen from some of these photographs the very beautiful outlines of the volcanoes in that country, and I do not think one really could exaggerate the beauty of Agua and Fuego and the lake of Atitlan. The view at sunset or at sunrise from the top of Agua or Fuego, with the sun tinting that long line of peaks, is exquisite. And the cloud effects are unrivalled. It is extremely interesting to me to see these photographs of Santa Maria, because the last time I saw it it was a perfect cone, and Quezaltenango was then a flourishing city. I can do no more than congratulate Dr. Anderson upon the work he has done, and thank him for the photographs he has shown us.

Mr. ASOOLI remarked that he had been in the country at the time of the eruption and of the previous earthquake, but that the details were too numerous to go into that evening. A feature of the eruption not mentioned by Dr. Anderson, and which might tend to elucidate the mystery of the destruction of Ciudad Vieja, was the following: During great activity of the crater, at night-time, about a week after the first outburst, the village of Santa Maria, situated on the south-eastern flank of the volcano, was awakened by a terrific roar, which continued during several hours. On investigation the following morning, it was seen that a tremendous torrent of water had swept down the mountain-side from near the summit, and had cut a channel about 17 feet deep and 83 yards wide from the road about a quarter of a mile below the village, carrying everything before it. Up to the present no satisfactory explanation has been given as to the origin of this torrent, for on no part of the mountain-side is there room for any quantity of water to have collected. It is surmised that the occurrence was due to the rapid condensation of steam emitted from the crater; but this seems hardly compatible with the immense quantity of water which descended the mountain-side.

Mr. A. H. GEBRKE: The pleasure we have all had to-night in hearing Dr. Tempest Anderson, and viewing the magnificent photographs that he has shown us, is in my own case greatly enhanced in finding some notice taken at last of one of the greatest volcanic eruptions of modern times, which, in respect of its intensity and scope, considerably overshadows those other and much more celebrated eruptions, which took place in the same year at Martinique and St. Vincent. True, the loss of life was, fortunately, not so great as at Martinique, though we probably lost more than two thousand in Guatemala, but the exact number will never be known. It was a remarkable fact, to us of the British colony, that the

Press in England barely noticed the eruption, some only mentioning it as a rumour from Washington. The contemporaneous German papers were, however, better informed of an event of such magnitude, and, indeed, in Germany volumes have been published by Dr. Karl Sapper, of Tübingen University, who had arrived in Guatemala the very night before the eruption broke out.

In order to give you some idea of the magnitude of the eruption, I must mention that Captain Saunders, the commander of the Pacific Mail s.s. *Newport*, which was off the coast of Guatemala at the time, says that he measured the height of the column of matter ejected, by his instruments, from the bridge of his steamer, and it was between 17 and 18 miles high, as near as he could reckon. The stuff was ejected in a north-westerly direction, and the fall of the so-called ashes extended as far as Acapulco, in Mexico, fully 600 miles away. On the other hand, the sound of the explosions travelled in exactly a contrary direction, to the south-east, and at Punta Arenas, in Costa Rica, also 600 miles away, it was so loud that people there thought that a warship was firing her guns all day long, "round the point." The deposit of the so-called ash—in reality pumice-stone, granite pieces, and their smaller particles forming a kind of sand—was, of course, deeper nearer the crater, where it still lies over 200 feet in depth, but it rapidly diminished with distance, till, at the frontier with Mexico, about 60 miles away, it only measured 13 or 14 inches, and from there on it tapered away gradually for 500 miles, until at Acapulco it was a slight layer of white dust. A rough calculation of what fell on Guatemalan territory alone—and it was only on that south-west corner that any stuff descended—shows the quantity to weigh well over 20,000 million tons, all ejected in those seventy-two terrible hours of complete darkness; and that is without taking into account the vast area in Mexico, thousands of square miles of deposit, inches deep. On our estate, "Helvetia," of which Dr. Anderson has shown you some interesting photos, and which has an area of about 5000 acres, the scoria lay from 7 to 12 feet deep, as it is situated only about 6 miles from the crater, and the total quantity we had on our land, we reckon, is not less than 50 million tons. The coffee-trees, which I can liken in size and shape to a good-sized lilac bush, say from 12 to 15 feet high, were just about buried in the ash, only a few twigs, leafless, of course, showing themselves above the surface. The houses and machinery had all been crushed flat; practically all the big forest trees still standing about on the estate were charred stumps, killed by lightning during the eruption; and the scene of devastation of what was once one of the finest coffee plantations of Central America, or indeed of anywhere in the world, was terrible to see. At the time of the outbreak there were nearly a thousand people working on the property, and that more were not killed is entirely due to the courage and devotion of the manager, Mr. Moesly, who stuck to his post, and imperilled his own life fearlessly in order to bring his labourers into as safe a place as possible; which was not very safe, however, as we lost some fifty lives as it is, amongst them that of the assistant-manager, Mr. Hartmann, who, with seventeen others, was crushed to death by a falling roof.

Some months afterwards, on revisiting the place with Mr. Moesly, we found some signs of promise. For one thing, there was more of the coffee-trees visible above ground. The heavy rains, most remarkable in their intensity, and due to the condensation of the immense quantities of steam continually issuing from the crater, had beaten down the sand to a more compact mass, and washed away a great deal besides, so that to day, after five years, we have only a deposit of from 3 to 5 feet on the place, which we are anxious not to lose, as we find it useful in keeping down the growth of weeds, besides other advantages. When we looked at the place five years ago, and four months after the eruption, and saw a few leaves

appearing, we realized that the trees we thought dead were still alive, and we determined to do our best to save at least some of the estate. We had a bitter struggle, and had to spend an immense sum of money, but we have succeeded in bringing the plantation to a state of perfection that it never had before, and the crops are, as a rule, much heavier and of better quality than previously. One of our greatest troubles was that of sickness, owing to the balance of Nature having been upset by the eruption, which, having killed all the birds for some hundreds of miles, enabled the flies, mosquitoes, and rats to multiply to such an extent that life to man became nearly unbearable. The immediate consequence was an epidemic of malaria, which cost more lives than the eruption itself—many times more. It has passed, happily; the birds having come again, the breeding of these pests is checked, and the district again enjoys the excellent reputation for health that it deservedly had before.

I wish to point out that when we commenced work on the plantation after the eruption, we did not know very well how to set about it; conditions were all changed, former experience was useless. There was no information available, and though there was advice in plenty, it was contradictory and not practical at all. We and all the planters on the coast were left to invent our own devices and methods, and whilst many may have been successful, others have not. Even to-day, now that it is all over, and the individual planters have either sunk or swum, it is not clear what was exactly the best way, and what was the real cause of failure or success. Now, I think that here there is scope for a proper scientific investigator, with a taste for seismology, to put on record the eruption itself and its after history and effects, especially with regard to agriculture. He would find a field of absorbing interest; he might confer great benefit on future victims of these occurrences in other parts by telling of our experiments and their results as compared with those of other planters on that coast, and he would find a hearty welcome at Helvetia, where we should be glad to extend him the usual hospitality and good cheer, and tell him as much as we know. I give the invitation from no selfish motive, as our results are attained, and we are out of the wood, and it is inconceivable that we should have another eruption of this nature in this neighbourhood, seeing that the open vent now acts mildly as a safety-valve. In fact, our volcano will now probably rest content with its little fling for a few centuries. The common experience of volcanoes, in Central America at least, points to the fact that heavy eruptions are never followed by others in that particular district. It is generally another volcano that has a turn; so we consider our situation as particularly safe and sound, and pity other poor people who have eruptions still to come.

Colonel CHURCH: Guatemala is not a little country by any means. Its area is about 47,000 square miles, and it is the most densely populated of any of the Central American states. I desire to call attention to the treaty which has been made very recently in Washington between the five Central American nations. In this, their representatives have agreed to abandon all their differences, to respect each other's territorial possessions, and to end revolutions. Should this lead to a federacy of those states, it is of extreme importance to the commercial and political world, and to the general peace of the American continent.

In the admirable paper to which we have listened, one item has struck my special attention, and that is the enormous distance to which volcanic dust is carried. Dr. Anderson said it was 600 or 700 miles. That reminds me that, about six years ago, I was visiting a cousin of mine in the United States, on Narragansett bay, near the famous watering-place of Newport. He has a country seat there, and he told me that soon after the eruption of Mont Pelée, perhaps about

ten days afterwards, he had a barn painted, and before the paint dried there came a fall of volcanic dust, which evidently had travelled all the way from Mont Pelée, about 1200 geographical miles. But, worse than that, a lady, who happened to be calling at the house during the dust shower, had not only her gown but her best new hat spoiled. All that remains for me now is to echo your wishes, and convey your heartiest thanks, not only to the lecturer, but to the gentlemen who have kindly favoured us by taking part in the discussion.

Dr. TEMPEST ANDERSON: I thank you for the very kind manner in which you have received my name. I assure you it has been a great pleasure to come here to-night to speak to you.

THE STORY OF LONDON MAPS.*

By LAURENCE GOMME.

IN order to consider properly the story of London from the maps, we must give some attention to London before the maps. London was a Celtic stronghold, as its name attests: it was appropriated as a Roman military camp, and grew into the proudest of Roman cities, *Lundinium Augusta*; it was utilized by the greatest of the Anglo-Saxon kings as a military defence against the encroaching Danes and men of the North; it was brought under the Norman dominion, and transformed into a city-institution of the English state by the great Plantagenet sovereigns. But of all these periods we have no maps; perhaps it would be safe to say no maps existed. But the question may well be asked whether any remains of these far-off periods cannot be restored to the maps? and a further and more significant question is presented to the student of London maps, Do not the maps themselves, coming to us in successive stages from the sixteenth century, contain remains of the earlier periods before the maps, some ancient landmarks, some unobliterated features which the cartographers recorded but did not create?

This last question is obviously an important element in the story of the London maps, for when we come to examine these precious relics of the past, it is borne in upon us that they contain much more ancient history than that belonging to Tudor times—topography that has never been obliterated. I shall be able to point out to you presently what I exactly mean by this. At the moment, I am anxious only to impress upon you the importance of knowing something of London before the maps in order to understand the London of the maps.

I will ask your attention, in the first place, to the stratification of modern London. It is not often possible to illustrate this, for those who have penetrated to underground London have not always been those who have understood or cared for the history of London to be

* Royal Geographical Society, February 10, 1908. Map, p. 588.
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obtained from these inaccessible regions. A good example, however, is afforded by a diagram made by Mr. Alfred Tylor in connection with discoveries made by him in 1881 in Warwick Square. In this the *débris* of the fire of London forms a very regular dark bed about 11 feet from the surface. The Roman remains were found at a depth of from 18 to 19 feet in disturbed gravel. This gravel had been temporarily removed in order to get at a bed of brick-earth which lay immediately beneath. This brick-earth the Romans had evidently, by the position of the moved gravel, worked out at this spot for brick-making, the gravel being thrown back again when the brick-earth was removed, as is the practice to this day in modern brickfields. Here, therefore, we have the original level of the land at the time of the Roman occupation.

Another diagram, of a section of underground London at Cannon Street, shows, beneath the level of the modern street, the roadway before the great fire in 1666; below this, earth in which Norman and Early English pottery has been found; below this again, a Roman tessellated pavement, and the soil beneath it containing Roman remains. Moreover, the London County Council possesses, in a drawing made by Mr. Fitzmaurice, the chief engineer of the Council, in connection with the absurd scare about the proposed sewer which was to have been constructed in the London Clay, evidence as to a section underneath St. Paul's Cathedral. These diagrams show the kind of city London has become through the successive periods of its history, and how deep down we have to dig before coming upon London before the maps.

The earliest London is the home of Celtic pile-dwellers, and the discovery of this fact is due to General Pitt-Rivers. The Thames was undoubtedly the site of lake-dwellings of the familiar type made known to us principally from the discoveries in the Swiss lakes, but also from discoveries in all parts of the British Isles. Thus, at Kew Prof. Boyd Dawkins discovered large oaken piles driven into the gravel which anciently formed the bottom of the Thames, with brushwood, principally willow, thrust in between them.* At the junction of the Fleet river with the Thames, General Pitt-Rivers made the most important discovery concerning earliest London. He found a number of piles the decayed tops of which appeared above the unexcavated portions of the peat dotted here and there over the whole of the space cleared. Commencing on the south, a row of piles ran north and south on the west side; to the right of these a curved row, as if forming part of a ring; higher up and running obliquely across the ground was a row of piles having a plank about an inch and a half thick and a foot broad placed along the south face, as if binding the piles together; to the left of these another row of piles ran east and west; to the north-east again were several circular clusters of piles, not in rings, but grouped in clusters, and the

* 'Trans. Prehistoric Congress,' 1868, pp. 271-272.

piles were from 8 to 16 inches apart; to the left of this another row of piles and a plank 2 inches thick ran north and south. A section, published by General Pitt-Rivers, shows piles roughly cut, as if with an axe, and pointed square; with no trace of iron shoeing on any of them, nor any appearance of metal fastenings on the planks. No remains of any tiles or bricks were found which might have formed a Roman superstructure on the piles, and General Pitt-Rivers therefore concluded that the superstructure, if any, must have been of wood or some other perishable material, and that it must have rotted with the tops of the piles. One other important detail must be mentioned—namely, that two human skulls were found without any other remains of the skeletons.

General Pitt-Rivers and those associated with him concluded, from the objects discovered, from the position of the piles, and from the evidence as to the growth of the peat, that these piles are the remains, not of river embankments by the Romans, but of pile-dwellings by the Celtic Britons, the skulls representing the practice known to have existed among these people of making trophies of the heads of their enemies. General Pitt-Rivers goes on to locate these pile-dwellings as the stronghold of Cassibelanus, which Cæsar approached and described as being situated amidst woods and marshes, and extremely strong both by art and nature. Still more recent excavations in the Wallbrook near London Wall by Mr. F. W. Reader lead to the conclusion that, generally speaking, the result of his work agrees with that of General Pitt-Rivers, and confirms very strongly the presence of a great Celtic stronghold at this place, the ordinary habitations of which were constructed as pile-dwellings in the Fleet river and in the lagoon to the north where Finsbury now is.

I venture to think that these discoveries effectually dispose of the idea of a great Celtic city of London. They show the London of the Celts to have been an ordinary tribal stronghold—ordinary, that is to say, in that it contained only the structures incident to tribal life, but undoubtedly one of the most important of such strongholds from a military point of view. A stronghold of the type Cæsar has described, situated on the rising ground of London, probably about where St. Paul's Cathedral now stands, with the waters of London all around it, was a place well protected from attack, and a place which could not well be left behind by an intruding army. It was the key of southern Britain. The contour-map of London will illustrate what the position of this stronghold must have been; and a picture of such a settlement, as it can be restored from the extensive remains which have been discovered all over Europe, will enable us to imagine what the London site must have been. A picture of another such settlement, restored from the famous Swiss discoveries by Dr. Keller (Keller's 'Lake Dwellings of Switzerland'), illustrates the general characteristics of

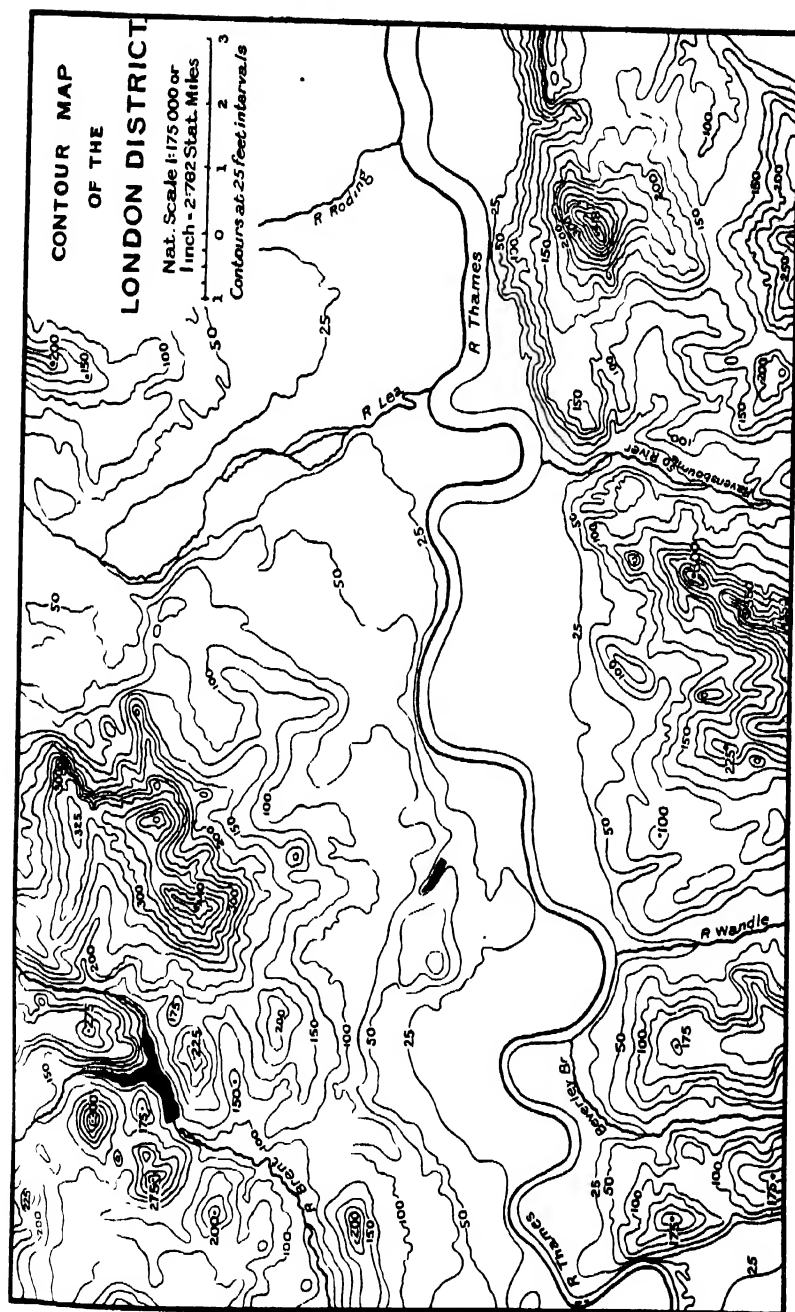
these lake settlements—the dwelling-places erected on piles in the waters of river or lake, the rising ground at the back converted into a place of defence when necessity arose, all of it in miniature when the London site is compared with the mighty proportions of the Swiss mountain site, but all of it of exactly the same type when we compare details, piles with piles, implements with implements, weapons with weapons, head trophies with head trophies, and even the indications they afford of a communal life.

For my present purpose we may leave Celtic London at this. The Romans recognized the military importance of London, for they established, very early in their occupation of Britain, a camp on the site of the British oppidum. This camp was rushed by Boudicca, and Roman Londinium arose from the ashes as the greatest city of Roman Britain—Londinium Augusta.

We have no maps of Roman London, though people have been drawing maps ever since they have attempted to discuss the site and conditions of Roman London. But all these maps are wrong. They have portrayed a walled city and nothing but a walled city. Roman Londinium, however, was not only a walled city, but a city with rights and possessions outside its walls—its sacred pomerium and its territorium, just as every Roman city possessed, modelled on the great mother-city of Rome itself. Fortunately, we can still draw an outline map of Roman Londinium from its later remains, and I will proceed to show the results so far as my own researches allow of this to be done.

First of all, the wall. The Roman wall occupied exactly the same site as the wall of mediæval London, a site which is well shown in our Tudor and Stuart maps. Before dealing with this feature, however, I desire to call attention to the actual remains of the wall. These are found below the level of the mediæval wall, and therefore only become known to us as excavation, and with excavation, alas! destruction proceeds.

The best example was revealed at Tower Hill. As an illustration of the general method of construction adopted by the engineers and architects who planned and erected the city wall, we have no better than that which was revealed on Tower Hill, and which has been so fitly and ably described by Mr. Roach Smith in his 'Illustrations of Roman London' (p. 15). Indeed, it was mainly due to his earnest endeavours at the time that this particular portion was not condemned to destruction. By Mr. Smith's exertions, it was saved from wholesale demolition and built into modern buildings. To a great extent, therefore, it is hidden by them, but it can be sought for now by any interested inquirer. This particular section had preserved its external facing. Another example was revealed in a very perfect condition in a section, over 70 feet in length, removed in order to meet the necessities of the Inner-Circle railway on Tower Hill, and



I will quote the account of Mr. Roach Smith of the examination he was enabled to make of this piece.

"The wall," he says, "was laid open quite to its foundation. A trench had been dug between 2 and 3 feet deep. This trench was filled in, or 'puddled in,' as it is termed, with a bed of clay and flints; upon this were laid boulders and concrete to about a foot thick. Upon the foundation was placed a set-off row of large square stones, regularly and neatly cut; then a bonding course of three rows of red tiles, above which are six layers of stones separated by a bonding course of tiles as before, from a third division of five layers of stones; the bonding course of tiles above these is composed of two rows of tiles, and in like manner the facing was carried to the top. The tiles of the third row were red and yellow, and they extended through the entire width of the wall, which was about 10 feet, the height having been apparently nearly 30 feet. The core of the wall is composed of rubble cemented together with concrete in which lime predominates, as is usual with Roman mortar. Pounded tile is also used in the mortar which cements the facing."

The keep of the Tower, it is said, was erected on the site of the second of the Roman bulwarks, and in an original drawing made by Mr. J. E. Price, may be noticed the situation of the Horse Armoury, the Wardrobe Tower, the site of Depository for Books and Papers, the Military Store-office, recently demolished, St. John's Chapel, apse of White Tower, and, adjacent to the south-east angle, a fragment of the Roman wall. In the section of the wall which has been exposed we note all the characteristic features of Roman masonry of a comparatively late period. It may be described as an ashlar facing of stone and tiling, enclosing a mass of concrete rubble. The carefully squared blocks of ragstone are well defined, as are the three courses of red bonding tiles, which may be seen in line throughout the wall, together with the ornamental plinth of ironstone blocks, forming a plain projecting face at the base of the wall, and at a short distance only from the ground. These blocks measure from 12 inches to 2 or 3 feet in length, and in their position accord with a similar method of construction still to be seen in the city wall at Carlisle and elsewhere.

Other fragments are a piece in the thoroughfare of London Wall, upon which a commemorative inscription has been placed; the comparatively modern bastion at Cripplegate; and a section uncovered in the Old Bailey, but now effectually blocked in.

There is also an exceedingly interesting fragment, inasmuch as the facing-stones are so well preserved and cared for, beneath the business premises of Messrs. Tylor in Warwick Lane. Further indications of the wall were discovered by Mr. Roach Smith at a depth of 14 or 15 feet in Thames Street. He traced it from Lambeth Hill to Queenhithe.* In thickness it measured from 8 to 10 feet, and its height, from the bottom of the sewer then in course of formation, was about 8 feet. It was constructed on oaken piles, over which was laid a stratum of chalk and

* *Archæologia*, vol. 29, pp. 150, 151, and 'Illustrations of Roman London,' p. 19.

stones, and upon this a course of hewn sandstones, each measuring from 3 to 4 feet by 2 and $2\frac{1}{2}$ feet, cemented with the well-known compound of quicklime, sand, and pounded tile. Upon this solid substructure was laid the body of the wall formed of ragstone, flint, and lime, bonded at intervals with courses of plain and curved-edged tiles; the construction, in fact, harmonizing, as do the measurements, with that observed along other portions of the line.

At Ludgate Hill was uncovered a magnificent section of the wall, which Mr. Philip Norman has figured and described.

Mr. J. E. Price has elaborately described the discovery of a bastion at Camomile Street. These bastions were the last to disappear. We have record, too, of square towers of Roman construction, one of which at the end of Gravel Lane was sketched by Gough in 1763, but which is now destroyed. Such towers are indicated on the later maps, as in the Ralph Agas map and in Newcourt's map of 1658, where two towers or bastions are marked between Newgate and Aldersgate.

It is a strange thing that the walls of London founded on the Roman wall should still affect, not only modern maps, but modern contracts, for whenever excavations have to be made near their site extra provision is inserted by the contractors for their destruction. And yet there is no direct record of the complete destruction of the wall. It appears in perfect order in Jeffery's Plan of London, 1735, and had disappeared from the maps when Rocque published his map in 1746. Active destruction went on about this period. Acts of Parliament were passed for improving the city, and there is an ominous list of "openings to be made in the City of London pursuant to an Act of Parliament passed this last session," printed in the *Gentleman's Magazine* for 1760, and nearly all relating to the wall. This Act was that of 33 Geo. II. cap. 80, and I will quote its title and preamble:—

"An Act for widening certain streets, lanes, and passages within the City of London, and liberties thereof, and for opening certain new streets and ways within the same, and for other purposes therein mentioned.

Preamble.—Whereas several streets, lanes, and passages within the City of London, and the liberties thereof, are too narrow and incommodious for the passing and repassing, as well of foot passengers as of coaches, carts, and other carriages, to the prejudice and inconvenience of the owners and inhabitants of houses in and near the same, and to the great hindrance of business, trade, and commerce, and whereas the said defects might be remedied, and several new streets and ways be made within the said city and liberties, to the great ease, safety, and convenience of passengers, and advantage of the publick in general, in case the mayor, aldermen, and commons of the said city, in common council assembled, were enabled to widen and enlarge the said narrow streets, lanes, and passages, and to open and lay out such new streets and ways, and for those purposes to purchase the several houses, buildings, and grounds which may be necessary to that end; wherefore," etc.

Within these walls have been found Roman remains of almost every description. This is not the place to describe them, but I have

proceeded far with a map of London, marking the spots where these remains have been found, and when complete this map will not be among the least important of London maps. An idea of the important results which may be expected from such a map may be gathered from the examples, reproduced in C. Roach Smith's 'Illustrations of Roman London,' of a few Roman pavements which have from time to time been discovered in London, in Threadneedle Street, in Lothbury, and in Leadenhall Street, all of them beautiful specimens.

These Roman walls are also modern boundaries, for all the city wards are stopped at the wall, and the modern map of the ward boundaries thus reproduces a condition of things which is due to Roman times or to Roman structural remains being left undestroyed. We can see this by shortly following the line of the ward boundaries where they touch upon the wall.

Commencing at its eastern end, we have to eliminate the Tower of London, and start from a point at the Thames shore in a straight line opposite the eastern end of Trinity Mews, above Postern Row. The liberty of the precinct of the Tower is bounded on part of its eastern side by the line of the Roman wall skirting Trinity Mews. From thence the wall follows the eastern boundary of the Tower ward and then follows the boundary of Aldgate ward, at the back of the Minories and across John Street, George Street, and Aldgate, where an interesting deflection in the boundary of the ward denotes the site of the gate. The wall next bends westward with the boundary of Aldgate ward, proceeding at the south of Houndsditch along the north side of Duke Street, and then north of Bevis Marks and Camomile Street. The wall then proceeds with the boundary of Bishopsgate ward across Bishopsgate Street, where the gate stood, then north of Wormwood Street. Thence it proceeds with the boundary of Broad Street ward along the centre of the street called London Wall. At this point a curious thing happens. Coleman Street ward crosses the line of the wall, and takes in the whole of a square area enclosing Finsbury Circus beyond the wall, but when the boundary of Cripplegate ward begins it again follows the line of the Roman wall. Cripplegate ward has a curious long narrow strip of territory, which takes in the site of the wall and nothing further. At the point where stood Cripplegate the ward of Farringdon begins, and its boundary follows exactly the line of the wall, turning off at right angles towards the south, and showing no less than three bastions along its course from Cripplegate Church to Falcon Square. Here is Castle Street, a very significant name in this connection. Below Falcon Square, just opposite Oat Lane, the wall turns again in the direction of east to west, and follows the boundary of Aldersgate Ward and of Farringdon ward to a point in Christ's Hospital grounds (now unfortunately built over), where it again turns sharply southwards towards the river. The northern boundary of

Farringdon ward appears to extend slightly beyond the line of the wall, but the ditch or moat outside the wall was, until the year 1908, commemorated in the school grounds of Christ's Hospital by a drain course known as the "town-ditch." The wall proceeds along the ward boundary at the back of the Old Bailey and crosses Ludgate at the point where the old gate stood. From this gate to the Thames the ward boundary is not followed, the wall crossing the space now occupied by the *Times* printing office, and turning south to Thames Street.

The modern maps still reveal traces of Roman London in the arrangement of the city streets. Some of the cross streets running at right angles to those running from east to west are probably on Roman foundations.* Formerly the north and north-eastern traffic went either by Gracechurch Street to Tottenham by the old Roman road, or, starting from east to west, it left the city by Aldersgate, and thence by St. John Street to the north. There was no break in the city wall between Aldersgate and Newgate, and the large block of ground without carriage-way about Grey Friars is a consequence of the Roman wall affording no passage. These are relics of the ground plan of Roman London which justify the archæologist in stating that "it is remarkable how the Roman wall (only passed by a few gates) and the street plans laid down by the Roman road surveyor turn even modern city traffic in the old directions,"† and perhaps these words fitly complete my account of the internal portions of the city.‡

So much for Roman London within the walls. As I have already explained, Roman London did not stop here. It extended beyond in two different and important particulars, and we will now turn to this important feature.

First of all, there was the pomerium, a sacred belt of land all round the city, preserved in its natural state, never built upon, and occupying an important position in the constitutional and legal rites of the Roman city. Now there are so-called liberties without the city wall, liberties which have been divided into wards, and which are known as London without the walls—London without distinguished from London within the walls. The origin of this extra-mural part of the city proper is lost in antiquity, but considered from the point of view of history, there is little difficulty in taking it to represent what remains of the ancient pomerium of the Roman city. On the modern map of London city, therefore, we have not only the line of the Roman wall, but the outline, at all events, of the sacred pomerium.

* See *Archæologia*, vol. 33, pp. 102-103, for interesting details on this point.

† Mr. Alfred Tylor in *Archæologia*, vol. 48, pp. 226-227.

‡ The Roman remains of London have been topographically catalogued by Mr. J. E. Price in *Archæological Review*, vol. 1 pp. 274-281, 355-361.

We now proceed to other signs of the connection between the city and the outside territory. At Rome, and because at Rome, therefore at every other colony or municipality in the Roman empire founded upon the model of the mother city, the military jurisdiction of the consul could not be asserted without appeal; beyond Rome it could be so asserted, and the limit between the two spheres, the *imperium domi* and the *imperium militiae*, was originally not the city walls, but the pomerium beyond the walls, and then, later still, the first milestone beyond the city—*neque provocationem esse longius ab urbe mille passuum*.^{*} This consular jurisdiction included the pronouncement of the death sentence, and it is therefore perfectly reasonable to suppose that the "mile-end" from the city assumed an important place in local history.

Now let me turn to the Mile End of London. Mile End Bar was exactly one mile from Aldgate, the eastern gate of the city commanding the Roman road to Colchester and the eastern parts of Britain. It was the place where the citizens assembled in arms,[†] and it was a place of execution.[‡] A field at Mile End, known as "Hangman's Acre," is marked on Gascoyne's map of London. Here, then, are all the essential features of the Roman mile-end jurisdiction of the consuls reproduced in the London mile-end, and the twofold association of military and criminal matters cannot be an accidental parallel.

Always outside a Roman city there was an amphitheatre, where sports and fights were exhibited, where the people in fact held their public shows. The remains of the amphitheatres at Dorchester and Silchester can be seen in remarkable preservation. The position of the London amphitheatre has never been placed, but I have an interesting suggestion to make. On the Southwark side of London, where the Roman residential town had extended, is a place still called the Bear Garden. It is now an octagonal space built round with houses. But this octagonal space is derived from a previous octagonal building, which stood there in Tudor times, and was one of the theatres of that age. Thus this site is connected with shows for a period of time which takes us back to the Southwark of green fields. Then its name Bear Garden shows it to have been the place for the sport of bear-baiting, and this carries us back centuries. Beyond that there is no record until we come to a very singular and interesting relic, discovered on this site a few years ago, namely, some gladiator's trident.[§] These tridents were used by one class of the Roman gladiators in the

^{*} Livy, iii. 20. See Greenidge ('Roman Public Life,' p. 79) for a full description of this interesting point in Roman city life.

[†] 'Liber de Antiq. Leg.,' p. 7. A vivid description of this in 1381 is printed in Riley's 'Memorials of London,' p. 449.

[‡] Nicolas, 'Chronicle of London' (fifteenth century), p. 73.

[§] Brit. Arch. Assoc., vol. 27, pp. 305-312.

amphitheatre, where they fought for the amusement of the people. I cannot help looking at the continuity of use expressed in these facts, and in the modern octagonal group of houses known as the Bear Garden, I think we have the last remnants of the amphitheatre of Roman London.* The site is best seen on Rocque's map of 1750, and on the ordnance sheet of to-day.

Of more consequence to us is the map of London, with its territorium. This was its special property, and it extended as far as the limits of the territorium of the nearest Roman city, or as near thereto as the natural boundaries of forest swamps or other features allowed. It is impossible, of course, to trace in detail the boundaries of the territorium now, but there may be points on the line which for one reason or another have become distinguished, and it will be sufficient if we can trace out any such points. If the territorium of London extended as far south as to meet the territorium of the nearest Roman town, namely, Durobrivis (Rochester), the actual point of contact may be discovered by a fact brought out by the Saxon conquest. The Jutes landed in A.D. 449 or 450, and met the British force at the passage of the Cray, a comparatively small stream, even at that date. Their victory was complete, for the Britons, as the 'Saxon Chronicle' tells us, "forsook Kent-land and fled with much fear to London." Now the question may be asked, what was London to them? If we note that the river Cray was the southern boundary of the Londoners' right of chase in the Middle Ages, and if we bear in mind that the charter of Henry I. alludes to these rights as based upon ancient custom, it seems reasonable to suggest that the Cray represented the boundary point of the territorium of Roman London. The men who fought at this boundary, and who on defeat fled to London, were then defending the territorium of London at its furthest point, and were therefore the armed force of the Roman city. I am tempted to add that the "white horse stone" at Crayford, and its traditional connection with Horsa, is in reality one of the many "hoar stones," the Saxon name for important boundary stones, and to be found in all parts of Roman Britain, but, it is significant to add, not outside the Roman sphere of influence.

This conclusion as to the southern boundary enables us to go a step further in the question of the territorium boundaries, and we turn to the eastern side. There is evidence of a decided character that the boundary between modern Middlesex and modern Essex was also a Roman boundary, for Old Ford was an outpost which marked a point of importance, and nothing so important could have arisen as the structure

* An important parallel to this evidence is provided by Cirencester, where the remains and site of the Roman amphitheatre were well known, were used in later times, and were then known as "the bull ring" ('History of Cirencester,' 1800, p. 69). The comparison of the facts of Cirencester with the theory as to London is an important aid.

which divided the territorium of Lundinium from its neighbour. Of Roman remains at Old Ford there is ample evidence—burials, coins, and urns being the chief objects, and it is just possible that the attempt in mediæval days to make Old Ford a sort of trading boundary for London may rest upon some reminiscence of more ancient conditions.

We will next turn to the west. Staines marks the boundary of the city's ancient rights in Middlesex and on the Thames.* Now, Staines had a special connection with London, for a charter of King Eadward grants to Westminster Abbey the "cotlif" of Staines with the land called "Stæningehaga" within London.† Prof. Maitland makes the acute suggestion that in the names of Staining Lane and the parish of St. Mary Staining we have the means of identifying the locality of Staininghaw.‡

Let us finally turn to the northern side of the territorium. The nearest Roman city to London on the north is Verulam, and it happens that there is an important topographical feature, the history of which illustrates the point we are discussing. This feature is the so-called barrow on Hampstead Heath. It has been the subject of several traditions and much speculation. But one point stands out most clearly, namely, that this barrow was connected with both London and St. Albans. This is contained in a legend recorded by Howitt as follows :—

"In very early times the inhabitants of St. Albans, who aspired to make the town the capital of this part of England, finding London growing a vigorous rival, set out to attack and destroy it; but the Londoners turning out met and defeated their enemies of St. Albans on this spot, and this mound contains the dust of the slain."§

The barrow, however, disproves this, for its excavation in 1894, by the London County Council, under the scientific superintendence of Mr. C. H. Read, revealed no evidence whatever of any burial or cremation use. It did, however, reveal something far more important. Thus the excavations showed—(1) black masses as the centre was approached, indicating the presence of charcoal at varying depths from 3 to 5 feet from the upper surface; (2) as nearly as possible in the true centre of the mound an irregular hole or pocket, the top of which was 6 feet 6 inches from the upper surface, and extending downwards for about 18 inches; (3) charcoal, apparently vegetable from the tiny fragments of carbonized wood remaining in it,

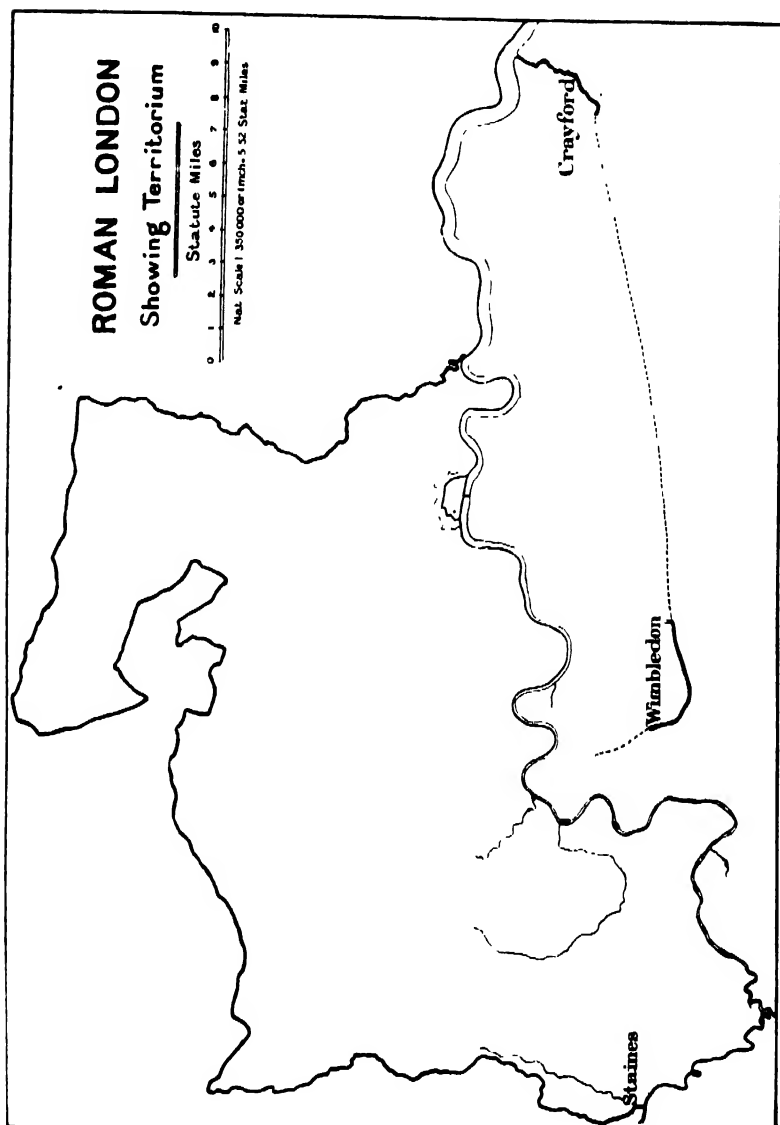
* See *Eng. Hist. Rev.*, vol. 17, p. 485.

† Komble, 'Cod. Dip.', vol. 4, p. 211.

‡ 'Domesday and Beyond,' p. 181; cf. Coote, 'Romans of Britain,' p. 378. There is also the parish of All Hallows Staining.

§ Howitt, 'Northern Heights of London,' pp. 329-300

in the hole or pocket.* There was absolutely no trace of any burial, or any of the associations of a burial. Now, noting one further point



* Minutes of London County Council, November 27, 1894, and Report of Mr. C. H. Read to the Council.

of Mr. Read's excellent full report, that the hole or pocket was made on the ground level, and that consequently the barrow was heaped up over it, this barrow exactly corresponds to the Roman *botontinus*, a mound erected by the *agrimensorial* surveyors for boundary purposes.

Thus east, west, south, and north there are signs of a boundary mark connected with the city, and it is at these points that we can trace the limits of the *territorium* of Roman London. This great stretch of territory was essential to the city for many purposes. It was traversed by roadways, for five of the great roads of Roman Britain made their way to London. It was cultivated by the Roman *servi*, the native population, no doubt, who thus had to administer to the necessities of their overlords. It was dotted here and there with villas of favoured Roman lords; at Greenwich, in the Strand, at Westminster, at King's Cross, at Kingsbury, and in one or two other places, remains have been found. Southwark, of course, was a suburb continuous from the foot of the bridge. All this indicates the nature of the occupation of the London *territorium*. There were no towns, no villages, no home-steads; it was all territory belonging to and used by the great city.

The *territorium* of Roman London was broken up. The church had the first bite. It is clear, by a comparison with the recorded events in the case of other Roman cities in Britain, that the church obtained from Anglo-Saxon monarchs extensive grants of Roman city lands. Carlisle and Winchester are the best examples of this process. The records of the transaction at London are not preserved, but again by using the maps we may trace out the story. The manors belonging or once belonging to St. Paul's cathedral stretch all round the city, but their boundaries stop at the city boundary. This fact is most significant. Their limits within the Roman *territorium* of *Lundinium* are thus demonstrated, and this, coupled with certain historical facts, show how the Roman *territorium* of London passed into the Church lands of later times.

I submit to you that this accumulation of Roman indications is of constructive importance. One item only would not answer objections; two items would not answer them; but all that I am able to bring together, fragmentary as they are, independent as they are of each other, discovered as they have been by various means and from various sources, stamps them as authoritative remains of the Roman city. They are parts of the modern map of London. They owe their place on the map to Roman authority and Roman dominion. Such precious landmarks come to us sanctified by nearly two thousand years of human life which has been spent upon and around them, and the maps thus do us good service in showing how they have been preserved.

With this great Roman city stretching its domain over so vast an extent of territory and finding its way into modern life, we may compare the London of Anglo-Saxon times. If Roman London subtracts

from the modern map the city centre and certain special spots which belong to Roman times; it does not show us any other remains within its sphere of influence, and in this respect it affords a remarkable contrast to Anglo-Saxon London.

Anglo-Saxon London began, *not* within the walls of *Lundinium*, but without; not even at its gates spreading outwards, but from outside, gradually approaching nearer and nearer. The new-comers settled all round, and we may trace out on the maps the records of the settlement. I have marked the sites of all the villages mentioned in *Domesday* within the present county of London, and one cannot but be struck with the significant position they occupy on the map.

First of all, we may note the ancient settlements afterwards to grow into modern parishes, long, narrow territories stretching from the river to the hills. These settlements were arranged in English fashion, not Roman fashion. We see this by the maps. If we compare the manorial settlement round London with that of the more rural parts of the country—Wiltshire, for instance, would be an excellent example to refer to, and Dr. Slater's paper, read before this Society, will at once appeal to the members—we find them of exactly the same type. There is the homestead in the lowlands, near by are the meadow land and arable land, and stretching up towards the highlands are the open pastures and the forest. Examining some of these settlements a little more closely, let us take the maps of modern Kensington, Fulham, Paddington, St. Pancras, Islington, the great manor of Stepney north of the Thames, and Lambeth and Camberwell south of the Thames. Each of these shows the same characteristic mode of settlement: they begin down by the river, and stretch away from it northwards towards the heights; and again on the south of the Thames, they begin at the Thames, and stretch southwards towards the Surrey hills. We are conscious, however, of two disturbing facts: on the north there is the great territory south of the Roman road (now Oxford Street), known to us as Westminster, intervening between these ancient manors and the river, and there is a low narrow stretch between Westminster and the city, reaching from the Thames far up towards the north. No doubt the formation of Westminster and of Aldwych, from whatever cause or causes, intervened in the mode of settlement of the Anglo-Saxon manors, and similarly on the south there appears to be the ancient influences of Southwark interposing between the river and the normal manorial settlement. I believe these influences to be of later date than the foundation of the Anglo-Saxon manor, and I believe them to be of Danish origin in both cases.

Without attempting proof of this statement, I will detail one interesting feature in the proof that may be forthcoming as we learn to know better the significance of the teaching to be gained from London maps. At Kingston we have the sacred stone where Anglo-

Saxon kings in tribal fashion were elected to their kingship. At Thorney, now Westminster, we have another example; and the stone in the Abbey brought from Scotland is the later substitute for the earlier example of the King's Bench, from which the well-known court of law is named. But in the district of Aldwych, too, we have a record of the Danish settlement of the utmost importance. Just outside the walls of London, and between them and the ancient bounds of Westminster, was an unallotted district stretching from the river Thames up to the higher lands by the Lea. This territory is shown as uncovered by buildings on Agas's map. It did not belong either to Westminster or the city. It possessed a pound and stocks; its lands were both arable and pasture, and at its southern end, just opposite where Somerset House now stands, and perhaps on the very site of the pump and well in front of the church of St. Clement Danes, was a great monolith, the centre of many legal ceremonies, and at which the justices sat in the open air to deliver judgment down to the reign of Edward I. All this shows a strong constitutional organization. It was known by the name of Aldwych, and is apparently unknown to history. Its separate topography appears on the Elizabethan maps, and so late as the days of the Stuarts some vestiges of it remained in Oldwick Close, an open space which lay to the south of Lincoln's Inn Fields.

This village in the tenth century was largely colonized by the Danes, after whom the neighbouring church of St. Clement was named. The high-road of the village, which connected it with the hospital of St. Giles, was known as the *Via de Aldewych*, and is represented by the modern Drury Lane, with the exception of the south-eastern extremity, which led to the Holy Well of St. Clement, and the name of which survived in Wych Street, now restored to Aldwych (*Notes and Queries*, 9th ser. vol. 2, p. 81). The topography of the district can be partly made out from later historical documents. We find Henry I.'s Saxon wife making choice of Aldewych for her leper settlement. Where Charing Cross Road runs stood the old Blemundsbury manorhouse. Upon the ground east of it Matilda raised her hospital, dedicated to St. Giles. Next came the old church of Aldewych, with its lyohgate, and close beside the Clocke Hose, whence the Curfew tolled. It was probably here that criminals, on their way to the gallows, paused for a minute to receive the bowl, or cup of charity, and then passed on down Elde Street, turning to the left through Le Lane into the fatal Elm Close with its two tall trees. Opposite the church stood the village pound, and the stocks a little further eastward at the junction of Drury lane (*Via de Aldewych*) with Watling Road (Oxford Street), where Hugh Le Faber worked his smithy, and just facing Drury Lane rose the village cross and the well (*Fontem communem*). In Plantagenet times (1200) we can trace five cottages near the smithy, and on the opposite side of Drury lane, facing Holbourn, stood the Christemasse Mansion. This mansion

became an inn in the time of Richard II., and adopted his badge, the White Hart, as its sign, and was so known until its destruction in 1807, when it had become the White Hart Yard. The hospital, indeed, had been dissolved in 1539, but just previously King Henry VIII. had acquired the property of St. Giles Hospital in exchange for land in Leicestershire, and it only boasted of three messuages then. In the indenture then drawn up we find specified: (a) 25 acres of pasture lying in the village of St. Giles; (b) one messuage called the White Hart and 18 acres of pasture; (c) one messuage called the Rose and one pasture. This represents the Aldewych lands formerly divided into (a) Aldewych West, (b) Aldewych East, (c) the Campum de Aldewych.

(a) Aldewych West was that region bounded west by the Via de Aldewych (Drury Lane), east by Newland (Belton Street, Short's Gardens, etc.), St. Giles Street (Broad Street) on the north, and Long Acre on the south.

(b) Aldewych East, or the White Hart and Rose messuages with pasture land, was bounded north by Holborn, south by Great Queen Street, west by Drury Lane, and east by Little Queen Street. Spenser's ditch, afterwards the common sewer, divided it into two.

(c) The Campus de Aldewych, afterwards known as Oldwick Close, was bounded east by Lincoln's Inn Fields, west by Drury Lane, north by a footpath, now Great Queen Street. Southward it stretched over 16 acres to Wyoh Street, half in the parish of St. Giles and half in that of St. Clement Danes. A footpath, afterwards Princes Street (now Kemble Street) divided the parishes.

With the exception of a few Drury Lane mansions, Aldewych retained its pastoral character throughout the reign of Queen Elizabeth. For we read that—

"There were certain parcels of land by estimation 50 acres holden of her Majesty by lease, sometime of the possession of Burton St. Lazarus of Jerusalem, which in times past had been Lammas and errable (*sic*) which was then divided, hedged and ditched, for meadow and pasture, and ought to be common at Lammas from St. Giles to Hyde Park and towards Knightsbridge and Chelsea."

Leaving all the details for close consideration, we have here the remains of a Danish settlement in London, outside the city, and containing all the features of Danish life in its earliest stages, when judges sat in open-air courts, and tribal kings were elected at great stones held sacred for the purpose.

Tothill Fields in Westminster is another centre of the same historical origin, and it is curious that there was a Tothill street just off Gray's Inn Road, near the Holborn end. Now, Tothill is undoubtedly a name of Teutonic origin, and the doings at Tothill Fields take us back to the holmgangs of the Danish tribes, where disputes were settled by the duel and judicial combat, instead of by law. The last example occurred so recently as the "spacious days of Queen Elizabeth."

There is, however, something more than the mere outline and fragments of such settlements. There are the traces of the internal system of economy. The village community system has been well examined in this country by Mr. Seebohm, Mr. Slater, Sir Henry Maine, myself, and some others, and one definite fact about it is the peculiar arrangement of the arable lands. No one owner possessed wide stretches of land, but each owner—each villager, I should say—held his acre strip side by side in definite rotation with other villagers, so that one holding of sixteen acre strips—the normal holding—was situated in sixteen different parts of the arable lands. This is well illustrated by an example at Laxton, reproduced in connection with Dr. Slater's paper read before this Society.

Now let me turn to the maps of London. First of all, I will introduce a word-picture from a chronicle narrative, the true explanation of which we owe to the scholarship and acumen of Mr. Seebohm. Edward the Confessor lay dying at Westminster, and looking out on the scenery he loved so well—his contemporary biographer describes the palace as "amongst fruitful fields lying round about it"—he saw in his delirium two holy monks, who foretold to him the coming disasters of the realm, which should only be ended when "the green tree, after severance from its trunk and removal for the space of three acres, should return to its parent stem and again bear leaf and fruit and flower." Only one picture could have conjured up this otherwise unaccountable vision. The green tree was no doubt suggested by an actual tree, growing out of one of the balks separating the acre strips of Thorney island, and the uneven glass of the king's window-panes would be likely, as he rose in his bed, to sever the stem from its roots and transplant it higher up in the open field, in an acre strip three acres off, restoring it again to its root as he sank back upon his pillow. "The very delirium of the dying king," says Mr. Seebohm, "thus becomes the most natural thing in the world when we know that all round were the open fields and balks and acres."

This word picture, so cleverly extracted from the eleventh-century chronicle, appears in graphic form on the eighteenth-century maps of London, and its last relic survives in the name of "Long Acre." Because the acre strips have never been destroyed or altered, because year by year they have appeared in faithful surveys of London, the modern map becomes evidence of Anglo-Saxon London.

Scattered over the modern maps of London are examples of these acre strips. In the new map of London, published in 1797, we have the acre strips shown particularly well in "Battersea common-field," and at Lambeth, Fulham, Camberwell, and Peckham. In Horwood's map of 1794 the acre strips of Bermondsey are well marked, and in a map of Wandsworth manor of 1787, the distribution of the acre strips is almost undisturbed. The common fields of Bayswater are noted in *Notes and Queries*, vol. 1, p. 162.

I remember some years ago being shown by my friend, Mr. Walter Eye, the Norfolk antiquary, the singular conformation of the frontage of houses at Putney—one or two houses built up to a frontage line, and the next one or two built a little in advance, and a third a little further in advance, a fourth perhaps being a little behind; the only possible interpretation of such peculiar topographical features being that these were the terminals of the old acre strips upon which their owners had built the modern villa, and thus formed an irregular street front.

Perhaps, however, the most interesting example is afforded by Park Lane. The glorious irregularity of this most picturesque of thoroughfares was not due to street architecture. All that street architects could do is to be seen in the squares and streets at the back of Park Lane. What they could not do was to destroy the frontage line of the western boundary of these estates. You will remember Park Lane commences at the Oxford Street end in almost a straight line, due, I suggest, to a late cutting of the road to form Hyde Park, which took in a piece of the ancient continuation of Edgware Road at this point. After this straight-line commencement, terminating at about Wood's Mews, it is wholly irregular, and irregular in a very curious and interesting manner. The houses from Wood's Mews to Upper Brook Street are set back some feet; after Upper Brook Street there is a further set back up as far as the Mews, then a further setting back of the houses to Upper Grosvenor Street; after Mount Street the same features appear, until the triangular site of Dorchester House is reached, and beyond this to Piccadilly the frontage line is never straight, always one length at the back of another length.

I always believed that this irregularity was of the same nature as that at Putney already described, namely, the terminal points of the various acre strips, and proof of this is forthcoming if we turn to the "mapp or plot of the Lordship of Eburie being situated in the parish of Saint Martins in the Fields, Mary Dammison being proprietress; by Henry Morgan, 1675," in the Crace collection. At the top of the map is "the road from Knight Bridge to London," showing incidentally the bridge over the dip in modern Piccadilly, the site of the old stream of which the Serpentine is still a relic. The modern Park Lane is drawn on the eastern side of Hyde Park, but the eastern side of the road is not yet built upon. Running parallel to Piccadilly, and therefore at right angles to Park Lane, are the acre strips with the names of the owners recorded—

- (1) Sir William Poultney, proprietor.
- (2) Brickhill Fields, Thoby Beele.
- (3) Lee, Esq.
- (4) [Unnamed.]
- (5) Sir William Poultney, proprietor.

Sir William Poultney is thus owner of two acre strips separated by

London County Council, Park Lane is shown built on its eastern side from Oxford Street up to just beyond Chapel Street, and "Berkely Fields" remain unbuilt upon, and show a triangular strip, adjoining Park Lane, as belonging to Mr. Poulteney. This is exactly one of those "gores" of land so frequently found in unenclosed villages, and it is preserved to this day in the triangular site upon which Dorchester House now stands. We have the name preserved to us in Kensington Gore. Thus, although we have not the whole distribution of the acre strips revealed by the maps, there is no question that these indications are sufficient to show the nature of the holdings of the entire area. They were acre strips belonging to the village community system. The terminals of the acre strips in modern Park Lane remained unaltered, and they account to us of to-day for the splendid irregularity of the building-line of this most fashionable of London streets.

Summing up at this point, I hope I have succeeded in showing that the study of London before the maps is fruitful, and that it reveals Anglo-Saxon London with its homesteads in the fields in contradistinction to Roman London with its home life within the walls—two separate Londons, still delineated on the maps of London, integral parts of the story of London maps. I have also endeavoured to show the interest which attaches to the maps of London in the light they shed upon the period before the maps.

I have now to deal with some of the points relating to the later periods—the periods contemporary with the maps themselves, and which fortunately begin with Elizabeth's London, whose streets were trodden by Shakespeare, Marlow, Raleigh, Drake, Spenser, Cecil, Sydney, and all the host of great Englishmen and Englishwomen who began the task of making modern England, and with it modern London.

(To be continued.)

DR. STEIN'S CENTRAL ASIAN EXPEDITION.*

DURING the summer months immediately following my departure from Tun-huang (Sha-chou), archæological labours in the torrid desert plains would have been practically impossible. I was glad, therefore, to utilize this period in accordance with my original programme for geographical labours in the western and central Nan-shan. The arrangement and safe storage of the extensive collection of manuscripts, art remains, and other antiques resulting from my explorations about Tun-huang, kept me busy at An-shi until the close of June. It was fortunate that I selected this place, and not the neighbouring Tun-huang, for the valuable deposit; for in the course of local riots, which

* Communication from Dr. M. A. Stein, dated "Kara-Shahr, December 10, 1907."

broke out at Tun-huang within a few weeks after my departure, the yamen of the district magistrate, who had given much friendly help, and had offered to make himself responsible for the safe-keeping of my collection until my return, was completely sacked and burned down.

My first move from An-shi led towards the great snowy range south, which forms the watershed between the Su-lai-ho and Tun-huang rivers. On the lowest of a succession of barren plateaus built up by parallel outer ranges, I discovered a large ruined site at some distance from the village of Chiao-tzu. The ruins of the town, abandoned about the twelfth to the thirteenth century A.D., afforded interesting proofs of the process of desiccation, which has since materially altered the physical and economic conditions of the outer hill region. The stream, from which a canal, still traceable for a long distance, brought water to the site and the once-cultivated area around it, has completely disappeared. Only marshy springs remain, rising at the bottom of the broad valley on a level considerably below that of the ruined town. Of the force of wind erosion, which is almost constantly at work in this region, the walls of the town bore striking evidence. In spite of very massive construction, all lines of walls facing east, and thus standing across the direction of the prevailing winds, have been completely breached, and in many places effaced to their very foundation, while the walls facing north and south have escaped almost uninjured. The damage caused by erosion to the less-substantial structures within the town walls, and the height of the dunes covering the greatest part of the area, left little scope for excavations; but enough antiquarian relics were secured to prove that the site was inhabited up to the period above indicated. In the cañon-like valley in which the stream of Tashi cuts through the second outer range, I found an interesting series of Buddhist cave temples, still forming a pilgrimage place, and closely resembling in character and date the "Halls of the Thousand Buddhas" near Tun-huang, but less extensive. The large and well-preserved fresco compositions which decorate their walls supply fine illustrations of Buddhist pictorial art unmistakably Indian in origin, as practised in this region from the eighth to the twelfth century A.D.

After surveying the great chain of glacier-crowned peaks which overlooks the terribly barren outer ranges and detritus plateaus of the Nan-shan west of the Su-lai-ho, I and my companion made our way over hitherto unexplored ground to the foot of the mountains near the famous Chia-yü-kuan gate of the Great Wall. Here a short stay enabled us to clear up an archaeological problem of considerable historical interest in connection with the Great Wall. The imposing line of wall which bends round the westernmost part of the Su-chou oasis and extends to the very foot of the Nan-shan, has always been represented in books and maps as the end of the ancient Great Wall guarding the northern border of Kansu. Since centuries

travellers coming from Central Asia have greeted the big fortified gate leading through it as the threshold of true Cathay. Yet with this assumption it was difficult to reconcile certain early Chinese notices which seemed to place that famous gate much further to the west, and still more forcibly there spoke against it the remains of that ancient *limes* which my explorations of the spring had revealed as extending from An-shi westwards far away into the desert of Tunhuang.

The problem was solved when careful examination on the spot disclosed near Chia-yü-kuan the junction of two lines of frontier defence of widely different age and purpose. One line, represented by the crumbling wall of stamped clay which runs along the whole northern border of the Suchou and Kanchou districts, was proved by certain ruins to have originally continued westwards in the direction of An-shi and the Tun-huang *limes*, and to date, like the latter, from the second century B.C. Its manifest purpose was to safeguard the narrow belt of oases along the north foot of the Nan-shan, which was indispensably needed as a passage into Eastern Turkestan when Chinese political and commercial expansion towards the "western regions" had commenced under the first Han dynasty. The second line, which meets this ancient wall at right angles, and which the Chia-yü-kuan gate leads through, was shown by clear indications to be of far more recent construction, and probably does not go back further than the fifteenth to sixteenth centuries A.D. It was built for the very opposite purpose, that of closing the great route towards Central Asia and the west at a period when China had once more resumed its traditional attitude of seclusion.

Su-chou, the first town within the Wall, served as base for my expedition into the central Nan-shan. Considerable difficulties had to be overcome before we could start by the close of July, for the local authorities, swayed by fears about Tangut robbers, etc., tried hard to prevent me from moving in that direction. Even when they had acquiesced and resumed that helpful disposition which had invariably been shown towards me at all *yaméns*, the collection of the needful transport still proved a hard task. The Chinese settlers of the Kansu oases entertain a great dread of the mountains, which, in spite of excellent grazing-grounds and other natural advantages, remain to them a *terra incognita* beyond the outer scarps of the Richthofen range. Guides were obtainable only as far as the broad plateau-like valley between the latter and the Tolai-shan range, where some gold-pits, situated at an elevation of about 13,000 feet, are worked for a few months annually by small parties of more venturesome people coming from the side of Hsi-ning. After leaving these exposed mining camps, where the snow had barely melted by the beginning of August, no human beings were met with until we approached, towards the close of the month, Mongols grazing in the valleys south of Kan-chou. Fortunately, the well-defined character of the four great ranges in

which the central Nan-shan rises towards the uplands of the Koko-nor-Kharanor region, and the open nature of the main valleys between them, facilitated systematic survey work, notwithstanding the total want of guides. Excellent grazing was met everywhere in these valleys at elevations between 11,000 and 13,000 feet, evidence of relatively abundant moisture and a striking contrast to the barren slopes of rock and detritus presented by the western Nan-shan ranges at the same height. Thanks to the ample grazing, our transport animals escaped without loss, in spite of constant hard marching on high ground and over difficult passes. Plentiful game, chiefly in the shape of wild donkeys and yaks, warded off the starvation which, owing to their own improvidence, threatened to overtake the small party of Chinese soldiers the authorities had insisted upon sending along as an escort. More serious trouble arose from organized attempts at desertion among the other Chinese, which threatened again and again to leave us without transport, but fortunately could be suppressed without frustrating our plans.

By marches covering an aggregate of over 400 miles, we managed during August to cross and survey in detail the three northernmost ranges of the central Nan-shan, "all rising to peaks of 18,000 to 19,000 feet, between the longitudes of Su-chou and Kan-chou. All rivers descending to those oases, as well as the Su-lai-ho, which flows towards An-shi and Tun-huang, were explored to their glacier-fed sources. Wherever possible, we chose routes and passes different from those taken by the Russian explorers MM. Obrucheff and Kozloff, who had first traversed parts of this region. The magnificent ice-crowned range which divides the headwaters of the Su-lai-ho from the Koko-nor and Khara-nor drainage, was also surveyed along the whole length of its north face. Both in individual peaks and average crest-line its height proved to exceed that of the northern ranges. It was curious to meet in the wide mountain-girt basin, *circ.* 13,000 feet above the sea, where the Sua-lai-ho gathers its main sources, the same combination of marshes and drift-sand areas which is the characteristic feature of the desert depression where the river dies away between Tun-huang and Lop-nor. From there we made our way over difficult bog-covered uplands into the unexplored Alpine tract where the Tantung river, the northernmost large tributary of the Yellow river, rises, and after this short visit to the edge of the Pacific drainage regained the broad valley of the upper Huei-ho or Kan-chou river. Owing to the summer floods, no attempt could be made to follow the latter right through to the rock-bound gorge of its debouchure. But the devious route we had to take instead across the Riechthofen range offered ample compensation by the excellent survey stations found on the high transverse spurs we had to cross in succession. The deep-cut, tortuous valleys between the latter are clothed with luxuriant

forest, mainly firs—no small pleasure to eyes which had grown accustomed to associate mountain scenery chiefly with barren wastes of rock, gravel, or ice.

The total mountain area covered by Rai Ram Singh's plane-table survey, on the scale of 4 miles to the inch, between An-shi and Kan-chou amounts to close on 24,000 square miles. The positions of numerous stations were fixed astronomically by theodolite observations, and reliable height measurements secured for all important peaks and passes by means of mercurial barometer and clinometer readings. As a supplement to the topographical work, a large series of photographic panoramas was taken by myself, illustrating the characteristic features of the great ranges as they presented themselves from commanding positions above passes, etc.

From Kan-chou I commenced early in September the long journey which was to take me back to the Tarim basin for my second archaeological winter campaign. Several antiquarian considerations obliged me to follow on this journey the great caravan route *via* Hami and Turfan, which ever since the seventh century A.D. has supplanted the more ancient route past Lop-nor as the main line of communication between Kan-su and Turkestan. While travelling along it to An-shi I was able, by a series of reconnaissances northward, not only to survey that portion of the ancient Great Wall which was known at varying distance to flank the route as far as Chia-yü-kuan, but also to trace remains conclusively proving its earlier extension to An-shi. Our discovery at different points of this line, close on 170 miles long, was all the more gratifying because my explorations of the spring along the ruined *limes* in the desert west of An-shi and Tun-huang had already led me to assume this extension.

At An-shi, Surveyor Rai Ram Singh, who had rendered very valuable services during the Nan-shan expedition, but whose health had proved unequal to the hardships of a winter's work in the desert, left me to return to India *via* Khotan. Colonel Longe, R.E., Surveyor-General of India, had kindly agreed to relieve him by Surveyor Rai Lal Singh, whose zeal and fitness for surveying work under trying conditions have been tested by a long record of expeditions extending from Yemen to Eastern China. My tour to Mount Mahaban across the Indian north-west frontier had given me personal experience of his worth. Since I started from An-shi early in October, survey work has not been confined to the great route along which we were moving north-westwards. Both at the Hami and Turfan oases I was obliged to devote some time to visits of important ruined sites, though a variety of considerations precluded archaeological operations there. Full advantage was taken of these breaks in the journey for obtaining detailed surveys of those districts and the adjoining parts of the Tien-shan range. The numerous and extensive ruins within the Turfan oases, dating mainly from the Uighur period (ninth

to twelfth century A.D.), have been largely explored by successive expeditions of Prof. Grünwedel and Dr. Von Leocog, and have yielded a rich archæological harvest. Their inspection proved particularly interesting to me, owing to the close relation between their art remains and those which I had occasion to study and collect at the Buddhist cave shrines of Tun-huang. Observations I was able to make on changes which have taken place in the physical conditions of the oasis since the period of those ruins, will help to throw light on similar questions concerning more ancient sites in the Tarim basin.

In spite of these labours *en route*, and an aggregate marching distance from An-shi of close on 900 miles, I had reached the north-east corner of the Tarim basin in good time for the explorations of the winter. I was eager to devote them in the first place to any ancient sites which may have survived along the northern edge of the Taklamakan, among the protecting sands of the desert.

OCEANOGRAPHIC RESEARCHES OF HIS LATE MAJESTY KING CARLOS OF PORTUGAL.

By Sir CLEMENTS R. MARKHAM, K.C.B., F.R.S.

THE late King Don Carlos of Portugal was distinguished as a man of science and as an artist not less than as a statesman and as a patriot, but it is from the former point of view that his memory claims the respectful regard of geographers. From a child the future sovereign had a passion for the sea, and for many years he had given much attention to the study of natural history. A thorough sportsman, an enthusiastic sailor, a diligent promoter of agriculture, it was characteristic of this many-sided and gifted prince that, in all his pursuits, he never lost sight of the great object of his life—the good of his people.

It was in 1896 that Don Carlos of Braganza, as he always called himself in the title-pages of his publications, resolved to undertake the scientific examination of the Portuguese seas. His plan was to make a methodical study such as would augment and systematize the knowledge already obtained. Some oceanographic work had already been done off the coasts of Portugal by MacAndrew in 1847, by Mr. Peroival Wright, who dredged for sponges in 1867, by the *Porcupine* in 1870, by the *Challenger* in 1873, by the Prince of Monaco in 1894, and by the Lisbon Commissioners of Fisheries on board the *Lidador* in 1895. But much remained to be done.

King Carlos was deeply impressed with the importance of the fisheries to a large section of his subjects, and of the results to be derived from a methodical study of the distribution of different kinds of fish, the periods of their arrival, and of their habits. In this spirit

his Majesty's labours were commenced in 1896. All his three yachts were named *Amelia*, after his Queen. The first was very small, only 147 tons, and her extreme liveliness rendered the work on board very difficult. The King was always accompanied by his naturalist, M. Albert Girard, and by several naval officers, but everything was done in his presence and under his direct superintendence. He attended to every detail himself, and could himself do, and do well, all that he ordered others to do. In his preliminary report he has described the arrangements on board, the fittings of the different kinds of apparatus for sounding and dredging, the system of preserving specimens, and the actual work. He used all the latest inventions when he found them to answer his purposes better than any others, but he did not follow blindly. In some things he took a way of his own. For instance, he always used lines of aloe fibre made in the country, and he adopted many of the methods of his friends the fishermen.

In the first year excellent work was done near the mouth of the Tagus and off Cape Espichel. The deep off Albufeira was explored, and it was found that it was joined by a narrow strait to other deep places near the fishing village of Cezimbera and south-west of Cape Espichel. It was in these deeps that the most interesting specimens were found, some of them new to science. In 1896 as many as fifty-seven stations were fixed where soundings were taken and dredgings conducted, resulting in a large collection. The plankton also received attention, and a collection of the sea-birds was made from the Berlings to Setubal. Much work was also done in Cascaes bay. There was a public exhibition of the collection made in the first campaign of 1896, in the museum of the Polytechnic School at Lisbon.

A second yacht *Amelia* was obtained for the campaign of 1897. She was 300 tons and 320 H.P. The zoological researches of that year were conducted in the bay between Cape Espichel and Sines. There were 72 soundings and 63 dredgings at 56 stations, especial attention being given to collecting specimens of the sharks and dog-fish in deeper soundings, using a line of about 400 fathoms to twice that depth, which is sunk by a weight, and working from a boat which goes under sail to the spot where the line is to be lowered. The sail and masts are then lowered, and the boat is kept head to wind with oars. It requires practice to feel whether a fish is nibbling, and to tell when it is hooked. The thirty species of *Squali* that were collected are divided into coastal and abysmal fish. The King gives an interesting account of the way in which fish which have come dead to the surface, and off the hook, are retrieved by dogs of a special breed. His Majesty had two, named *Tejo** and *Sardo*.† When a fish comes up in this way, the dog jumps out of the boat and brings it back so carefully that the

* Tagus.

† The river of Setubal.

skin, which is very thin, is not even scratched. The King saw one dog retrieve an *Aphanopus* at a distance of 200 yards.

The oceanographic campaigns were continued annually from 1896. In 1899 the third yacht *Amelia* was obtained, of 650 tons, length 180 feet, H.P. 650. She was fitted with a laboratory, would make 10 to 12 knots, and suited admirably in all respects. All three yachts were built in England. In 1898 his Majesty had commenced his very important researches respecting the tunny fishery off the coast of Algarve. The fishery is conducted in the same way as on the coast of Sicily, by what in Portugal are called *madrugues*. There are three kinds of these fish on the Algarve coast, the *Orcynus thynnus*, or tunny proper, *O. alalonga*, or albacore, and *Euthynnus thunnina*, or bonito. In these researches the King expresses his acknowledgments for help received from Mr. Boulenger, of the British Museum, from Dr. Barbosa du Bocage, of Lisbon, and from his own naturalist and shipmate, M. Girard, who continued investigations respecting the tunny fishery on board the *Lidador* in 1900.

Impressed with the use that his researches would be to an important branch of Portuguese industry, the King determined to pay an annual visit to the Algarve coast. A series of questions was sent to the boat-owners and fishermen, their answers being compared with the actual observations of experts, and the results shown in carefully constructed tables. It was found that the three different kinds have entirely different times for going and coming. The tunny proper arrives in May and June, fat and heavy, going east, when it is called *atum de direito*. It appears again, very thin, in July and August, going west, the *atum de revez*. The going into the Mediterranean and returning occupies fifty-two days. The take in going up, in 1898, was 37,782; in coming down, 28,855. The king's researches had reference to the exact dates of coming and going of the three different kinds, the positions occupied off the coast in their courses to and fro, and the causes which influence the oscillations and variation of those positions. The conclusions arrived at are of great importance to this branch of Portuguese industry. The fishery continues for four months, and is one of the chief sources of wealth for Algarve.

In his Algarve cruise, the King was accompanied by his brother, the Duke of Oporto, and by the Marquis of Fayal, in addition to five naval officers and the naturalist, M. Girard.

After several years of study and observation, his Majesty was more than ever convinced that a great service would be done for the Portuguese fishing industry by the publication of a *catalogue raisonné* of all the fish frequenting the neighbouring seas, indicating their habitat with precision, the period of reproduction, of their arrival, the exact position of their lines of passage, and the methods of taking each kind which experience had shown to be the best.

In 1904 there was a second public exhibition of the collections. King Carlos was the Honorary President of the Lisbon Geographical Society, and the place selected was the Society's splendid hall, with walls adorned by statues of Portugal's great explorers and cosmographers. There is Prince Henry the Navigator, seeming to look down with approval on the patriotic labours of this worthy representative of his house. There too are Vasco da Gama, Tristam da Cunha, Albuquerque, d'Almeida, Castro, Cabral, Cortereal, and the great cosmographer, Pedro Nunez, whose rare 'Arte de Navegar' (1573) was possessed by the King, but is not yet in our library. Surely no more appropriate place could have been found for the display of such a collection made by the most worthy countryman of the mighty dead.

King Carlos divided his collection into five sections—

Costeira—fish found from the surface to 110 fathoms.

Abyssmal—below 110 fathoms.

Pelagica.

Bathypelagica—never ascending from the depths.

Pelagobathyca—abyssmal, but found at certain times of the day near the surface.

Among the most remarkable catches are the *Odontaspis nasutus*, Bragança, a species of shark new to science; the *Himantolophus Groenlandicus*, of which there is one other specimen in the Copenhagen museum, the *Aphanopus carbo*, the *Chelmydoselichus anguineus*, first discovered in the Japan seas, the *Panopaea Aldrovandi*, a bivalve mollusk, and the *Saccopharynx ampullaceus*, taken 7 miles south-west of Cascaes.

But the services of King Carlos to science were by no means confined to the ocean. He was equally active on shore, and he made his love of sport conducive to the advancement of scientific research, while taking an interest in the welfare of the agricultural people, and in their pursuits. Dressed like one of themselves, the King was well known on the hill-sides and in the farmsteads of Alemtejo.

His Majesty conceived a plan for preparing and bringing out a complete manual of the *avi-fauna* of Portugal. The first *fascicule* was completed in 1903, comprising the *Passeres* (*Turdidae*), with twenty large coloured plates. There are notes to each bird, recording the King's observations of its first appearance and departure, locality, and habits. The second *fascicule*, with nineteen coloured plates, included all the *Sylvias*, and was completed in 1907. Others were to follow, and the Introduction, which would have been most interesting and valuable, was to have been in the last number.

In the midst of all these patriotic activities, a foul and dastardly murder deprived his country and the world of science of this most gifted prince. Beloved and lamented by all that is best in the land, high and low, but especially by the fishermen of the coasts and the peasants of Alemtejo, King Carlos will be remembered in history as the worthy

descendant of the great Constable, and as a king who loved science not only for its own sake, but chiefly for its usefulness in furthering the welfare of his people. This is not the place to say more on the subject of the loss to his country. But we deplore the loss to science of an illustrious prince so suddenly cut off in the midst of such valuable work.

The young King Manuel II. has been pleased to present the present writer, through our colleague, Captain Ernesto Vasconcellos, with the works of his late Majesty, which will form a valued addition to the Society's library. Four volumes are in quarto :

- I. 'Resultados das Investigações Scientificas.' *Pescas Maritimas I.* Pesca do Atun no Algarve. Three coloured plates and 8 maps. (Lisboa, 1899.)
- II. 'Resultados das Investigações Scientificas.' *Ichthyologia.* II. Esquales obtidos nas costas de Portugal, 1896-1903. (Lisboa, 1904.)
- III. 'Catologo Illustrado das Aves de Portugal Sedentarias de arribação e accidentaes.' Fasciculo I. Aves. Passeres. Turdidæ. (Lisboa, 1900.)
- IV. Fasciculo II. Sylvias. (Lisboa, 1907.)

There are also four in octavo :

- I. 'Bulletin des campagnes scientifiques accomplies sur le yacht *Amelia*, par D. Carlos de Bragança.' I. Rapport sur les campagnes de 1896 to 1900. Fascicule I. Introduction. Campagne de 1896. Rapport Préliminaire.
- II. 'Yacht *Amelia*. Campanha Oceanographica, 1896.' (Lisboa, 1897.) Pp. 20.
- III. 'Catalogo das Collecções expostas.' 1903. (Exposição Agricola.)
- IV. 'Carrosses de cérémonies de fêtes de la Maison Royale de Portugal.' Exposition de Milan. 1906.

SOME AFTER-LESSONS TAUGHT BY THE CALIFORNIA EARTHQUAKE.

By JACQUES W. REDWAY, F.R.G.S.

I SPENT Christmas Day, 1906, in San Francisco. Standing at the top of "Nob" hill, a heart-sickening panorama presented itself. Nearly 9 square miles of ruins comprised the foreground, and only here and there could a sign of rehabilitation be seen. Two or three of the more important street railway lines were in operation, but not half the streets of the burnt district were passable except to foot traffic.

I spent a part of the week preceding Christmas of 1907 in the city, and a more wonderful transformation can hardly be imagined; it could

be realized only when it was seen. From 5000 to 7000 buildings were then under way, and during the time of my stay I was not out of hearing of the rat-tat-tat-tat of the machine-riveter and the hiss of escaping compressed air. The moral to which the machine-riveter points is the fact that San Francisco has learned an object lesson for application to every part of the world where earthquakes and human beings occur at the same time. The engineer, architect, and builder has been prompt to get this lesson by heart.

There is still the debatable question as to which was the more severe—the shock of 1868 or that of 1906. Those who suffered the experience of 1868, among whom I was one, are inclined to the opinion that it was fully as severe as that of 1906. So far as the damage to property is concerned, however, there is no question; setting aside the loss from fire, the destruction caused by the shock of 1906 was anywhere from three to five times as great as that of 1868. Nevertheless, it does not necessarily follow that the latter shock needs to have been greater in order to have produced the greater destruction.

In the first place, the buildings standing in 1906 which survived the shock of 1868—and there were many thousands of them—were nearly forty years older, and had also been subjected to the racking of many light shocks in the mean time. In the second place, the buildings erected as tenements and residences by real estate syndicates and speculating companies in recent years were notoriously flimsy. This applies not only to timber-frame buildings, but also to those built of brick or of stone. Some of the brick buildings erected in the past twenty years would not have stood alone; they were practically held up by the walls of better structures between which they were built.

The demolition of buildings too badly injured for repair, and the repair of structures not demanding demolition, led to the discovery of an important and fundamental fact, so far as there may be association between earthquakes and buildings, namely—that to escape destruction, a building must vibrate as a whole; if it vibrates in segments it is far more apt to suffer serious damage in even a light shock. Perhaps the first idea of the vibration of a building as a whole might be illustrated as a fairly rigid but slightly elastic body fixed as to its lower and oscillating at its upper end. But that is just what does not occur in earthquake vibrations; on the contrary, owing to inertia, the top of the structure tends to remain fixed, while the greatest amplitude of vibration is at the bottom. The careful observations of engineers and builders are almost a unit in the establishment of this fact. That the greater amplitude of vibration *might* occur at the top of the structure, if the conditions were right, goes without saying. The important fact in the present case is that it did not.

It is also good to know that buildings may be constructed so as to be secure against material damage by shocks even severer than those of

1868 and 1906.* In the Spanish-American countries situated in earthquake regions, the buildings are built of brick or of *adobé*, a sun-baked clay; rarely are they more than two stories in height. Often they are thrown down by severe shocks, but they nevertheless have a remarkable stability. Time and time again I have seen those same *adobé* buildings so badly broken and cracked that it seemed impossible to draw a square of 4 feet on the surface of a wall without crossing one or more cracks. But the owner complacently stuffs the cracks with thin clay and patiently awaits the next *temblor*. Perhaps it would not be incorrect to assume that the friability of its thick walls is the chief factor of the stability of the *adobé* structure.

Next to the brick chimney, which simply invites destruction, the ordinary brick building three or four stories in height was the type of structure that suffered most in California. It would be hardly true to say that the shock made a clean sweep of them, but those which were uninjured were few and far between, and were distinguished by two or more of the following characteristics:—

Foundations so strong and well bonded that they acted as a unit.

Well-built interior transverse as well as longitudinal walls.

Mortar containing about 20 per cent. of cement.

Lateral walls tied by means of joists or by iron rods.

Trussed roofs with tie-rods for the lower chords.

In many instances the collapse of a roof neither pinned to the walls nor trussed so as to maintain its own weight, caused the walls to spread and fall. This was noticeable in several churches and school-houses. In the great majority of brick buildings, poor mortar, thin walls, a careless bond, and lack of good interior walls were responsible for the collapse of the building. Stone buildings, on the whole, suffered much less than brick structures, and in power of resistance were comparable with the best type of the latter. There was not much apparent difference in the condition of the buildings made of stone facing with rubble backing and those of regularly cut ashlars. Most of them were expensive office buildings, in the construction of which money was not spared. Some of them were top-heavy; some were too rigid to be elastic. The buildings of Stanford University possessed both defects, although every effort was made to have them earthquake proof. It is now thought that the liberal use of tying-rods would have done much to save these buildings.

The Palace Hotel deserves a brief description. It was the first high building erected in San Francisco, and work on it was begun only a

* The shock of 1872 in Inyo county, California, was undoubtedly much severer, but the region was practically uninhabited and without large structures. Had a shock of the severity of this earthquake occurred in a populous region the loss of life and property would have been great. It is a strange fact that men working in the lower levels of mines scarcely felt the shock.

short time after the earthquake of 1868. Before its completion, there were but few buildings in San Francisco more than five stories in height. The Palace Hotel was nine stories above ground; it was faced with stone, but substantially the building was of brick. There were numerous cross walls; iron rods were freely used in reinforcing the outer walls; the masonry was the best in quality that could be devised. The walls of the building were scarcely injured by the shock. Other brick-and-stone buildings, not so lofty, but just as substantially built, except for the metal reinforcement, were far more seriously damaged. It is logical to assume, therefore, that the iron reinforcement added materially to its power to resist the shock.

The moral is obvious; brick-and-stone buildings of the class described are not earthquake-proof, and they should not be tolerated in an earthquake region—and it must be noted that San Francisco is traversed by several faults along which earthquakes are certain to occur.

Timber-frame or "balloon-frame" buildings may be constructed so as to resist severe shocks without material damage. Many such buildings stood on stilts; they were promptly dumped to the ground. Others were built on well-made brick foundations, but not being anchored to the latter, they were thrown down. The most common defect was a failure to continue the studding and frame-posts of the first story up into the second, breaking the joints at different elevations. It was a very common practice to break all joints in studding and posts at the top of the first story, starting all the timbers for the second story on the plane of the top of the first. It is evident that a house thus constructed has as many units as there are stories; it is equally plain that a very light shock will shatter such a structure. An old hotel, the Valencia, built in this manner, collapsed, splintered into a heap of *débris* at the first shock, with a dreadful loss of life.

The lessons of experience are—first, the frame must be a unit in structure, and not broken into segments at the junction of stories; second, there must be a good foundation to which the building is securely pinned; third, the roof timbers should be trussed or tied so that the roof is self-supporting, and also pinned to the frame; fourth, the chimney should be thick and strong below the roof-line, and loosely constructed above it. Built according to these specifications, a timber-frame structure is almost the ideal for a dwelling. The cracking of plaster ceilings and walls will be the chief damage. The necessity of pinning the building to the foundations is shown in the fact that many which were not thus secured were thrown from their foundations, and several were shot into the ocean.

The buildings which suffered least of all were the high "skyscrapers." Briefly described, these buildings consisted each of a well-braced steel cage encased in stone and brick. Several of these were twelve stories in height; some were even higher. In many instances

these buildings were constructed with self-supporting walls of masonry, and it is interesting to note that they suffered more damage than those whose masonry rested on the steel frames. So little was the damage to the steel cage "cased" buildings, that nearly all the high structures now in construction are of this class.

Some incidental lessons are also apparent. The old axiom that the triangle is the only figure that cannot be changed in shape without changing the length of its sides is still true. The moral is, that diagonal framing, wherever the structure will permit its use, is yet a virtue; and the same is to be said of the generous use of knee braces and spandrel girders. Interior and exterior facing stones or brick should be most carefully bonded, front to back; and the use of lean mortar is but little less than a crime.

There were practically no buildings that afford a serviceable knowledge of the resisting power of reinforced concrete. Many of the buildings now under way or recently completed are of this kind, and it is the judgment of conservative engineers and builders that confidence in their stability against earthquakes will not be misplaced. In the past, severe shocks have occurred along the San Andreas fault, which traverses San Francisco, at intervals of thirty or forty years. It is reasonable to assume that they will occur also in the future.

In conclusion, a contribution on the mechanics of building and of structural engineering may not be strictly logical in the pages of the *Geographical Journal*, but it is a sort of knowledge that should become as widely diffused as possible. San Francisco has paid more than a quarter of a billion of dollars to obtain the knowledge taught by this object lesson, and she is willing that the rest of the world shall be a kindergarten class to avail itself of the knowledge which she has obtained by experience.

THROUGH EASTERN TIBET AND KAM.*

By Captain P. K. KOZLOFF.

On June 11 the caravan recommenced its march, accompanied by the Tangut guide, proceeding up along the nullah towards the pass, which I had previously reconnoitred, reaching the summit without mishap by 9 a.m. A few moments before our arrival a bear had passed along the top of the ridge, and, evidently scenting us on the breeze, had rapidly hurried off amongst the rocks. On this—our second—visit the pass received us with anything but hospitality. The sky was overcast, while grey dismal clouds, detaching themselves from the higher wool-enveloped peaks, at times sprinkled the hill with thin snow. No voices of birds could be heard in the cold air. The view to the south was equally depressing, for we could scarcely make out even the whereabouts of the lake, which had before seemed so clear as to make us think it was at no great distance.

* Continued from p. 415.

Descending into the valley, we pitched camp on the first grassy spot we came to, which, judging by the traces of fires, had been fairly frequently visited by local shikaries. The weather still continued to be bad, and a cold gusty wind brought home to one the full extent of the inclemency. Snow fell all night, so that in the morning we found the ground covered with a white mantle some 6 inches deep. The thermometer fell to 7°, and it seemed like winter, but the sight of a dark snowless tract of country away to the south, near the Oring-Nor, assisted to alleviate our misery. The cause of this tract alone having escaped the snow was explained by our guide as follows: "This phenomenon is common to the winter as well as summer, and, according to old men, has been visible from immemorial times, ever since the arrival there of a wonderful black fox."

When the weather cleared we proceeded down the valley, steering for the nearest bay in the northern shore of the lake. The snow soon melted, especially when the sun peeped out from behind the moving clouds. Nature again came to life, and larks, both large and small (*Otocorys Elwesi* and *Calandrella tibetana*), flying from hillock to hillock, gladdened the air with the sweetness of their song. Having forded a muddy and dirty yellow stream, which in places left its flat flinty bed, we hastened across a piece of dry snowless ground. However, as the lake was still some distance off, and as we had to feed the starving animals and dry our tents, etc., now heavy with moisture, we retraced our footsteps to the stream which we had left, and pitched camp for the night. By ten o'clock the following morning, June 13, the white tents of the expedition were marking the source of the noted Chinese river, or rather its place of exit from the Oring-nor, whose greeny-blue waves were noisily lapping its sandy shores. On the afternoon of our arrival here we met a party of Tibetans of the N'golok tribe, consisting of four men, whom we received with the usual hospitality. They told us that they were only the small advance-guard of a numerous N'golok caravan, encamped on the north-west shore of the neighbouring lake—the Tso-Knor. The number of these pilgrims, who were returning from Lhasa to the Yellow river, or Ma-chu, they placed at 600 men, women, and children, who were divided into eighty fires, or groups, under the command of one of their chiefs (Rinchin-sham) with two thousand animals—bulls and horses—and small flocks of sheep, driven in the rear of each of their echelons. To our other questions they either refused to reply or answered cautiously, despite the generous gifts we offered, and which they willingly accepted. The substance of our conversation both at this and at subsequent meetings with N'goloks was briefly as to the nature of the valley of the Yellow river to the east, their mode of life, and their internal administration. When we expressed a desire to proceed along the valley of the Yellow river, and to become personally acquainted with the mode of living of these independent Tibetans, they expressed the greatest displeasure, and endeavoured to change the conversation.

When they came to our camp they pretended not to look at our equipment and arms, endeavouring, evidently, to hide the natural curiosity which these produced. Noticing this, we made a point of showing them our "three-line" rifle with its magazine. "Although your numbers are few," said one of them, "no one insults you; your valuable rifle will always protect you. The N'goloks can only get the better of you by stratagem and cunning. For instance, having got into your camp in the guise of merchants selling eatables, with a party of thirty men or so, and having, at a given signal, suddenly drawn our swords and fallen upon you, we could kill you all in a couple of minutes. You cannot always wear your arms when out in the open valley." Afterwards, when they had been shown the latest things in revolvers, they were still more delighted, and remarked, "The

Russians are too well armed for such a plan to come off. They would pull these little guns out of their pockets and kill us before any of us could do anything." "I remember," continued one of them, "how we tried to fight some men like you in the Amne-machin, but nothing came of it, save that many of us were killed."* "Hulloa, my friend," thought I, "you and I are old acquaintances." And, interested with what he said, I asked him where the men of whom he was speaking had been going. Without a moment's hesitation, he replied, "To the monastery of Rarchha-gomba, which they probably would have reached if one of their commanders or officials had not lost his head, which was the reason why the Russians were compelled to return to the Toso-nor."† Thus ended the interview with the first N'goloks whom we met.

On the way to the Oring-nor, and also when camped by its shores, we saw the principal N'golok caravan on the march, moving by sections. It was split up into families, the children, both big and little, being carried in open boxes or baskets on either side of the animals, while infants were carried in their mothers' bosoms. Their household effects were carried on yaks. For two whole days the long string passed within sight of our camp, and while watching the march of these wild hordes, I was forcibly reminded of ancient history and its descriptions of the incursions of the Huns, Goths, and other nomadic races into Europe.

Judging that we should spend a considerable portion of the summer in the bend of the upper Hoang-Ho, so as to put in a lot of geographical, ethnographical, and natural history work, I made up my mind invariably to maintain friendly relations with nomads, and in particular with the N'goloks, with whom Russian expeditions had already most unfortunately been compelled to fight in self-defence. We were, accordingly, delighted at meeting the N'goloks on their way home, under the leadership of one of their principal men, and we hoped by friendliness and getting to know each other so to gain their good will as to secure a safe conduct down the unknown upper reaches of the river. As soon as we had pitched our camp by the lake on a nice piece of ground, which lent itself admirably to defence, three of them arrived to visit us. An old man—a Mongol-N'golok‡—who was assistant to Rinchin-sham, and two other Mongols, not counting some seven men who composed the former's escort, constituted the party. Among the escort were some fourteen-year-old lads, who tried to show off their skill with their weapons as well as their horsemanship. The Mongol-N'goloks had long ago become tibetanized. They had intermarried with the N'goloks, spoke Tibetan fluently, and, to look at, had the same type of features as the Tibetans. After dismounting, these Mongol-N'goloks, though armed to the teeth, calmly walked into our camp, and only parted with their arms at our request. Then, taking the seat usually reserved for guests, after in a few words welcoming us, they asked who we were, and whither we were going? I replied that we were Russians, that we had come from a great distance, had made the acquaintance of many countries and peoples, and that we hoped soon also to be able to visit their land. And I added that we were, therefore, most glad of this opportunity of getting to know the bravest of the Tibetan tribes, for whose chieftain we had brought some handsome gifts. "I hope," I concluded, "that nothing will happen to prevent my maintaining good relations with your chieftain, and that guides for our trip down the river Ma-chu will not be refused

* He referred, evidently, to the attack made by the N'goloks on Roborovsky's expedition in the Amne-machin mountains.

† Roborovsky had a paralytic seizure just before the N'goloks attacked us.

‡ These Mongol-N'goloks, or Mongols of the Ma-chu, are divided into four camps.

us." To this the greybeard, without a moment's hesitation, and without even referring the matter to Rinchin-sham, energetically replied, "He won't give you a guide. I will let you know whether he will grant an interview to one of your assistants, both for the purpose of receiving your presents as well as for personal conversation."

After an hour's conversation they got up to go, tasting, however, some tea and sweets before departing.

The reply, which we so anxiously awaited, was eventually brought to us by the same hoary-headed old diplomat, who announced his message as follows: "Our prince neither desires your acquaintance nor your friendship, and consequently declines to provide you with a guide. Acquaintance with him and guides provided by him would not in any case give Russians a safe conduct, as an armed conflict might easily ensue between them and others not under his immediate authority. A quarrel is more likely to arise with the inhabitants of camps under the other six princes, for which Rinchin-sham might, if he had assisted you, be held responsible. Only last year, 1899, on receiving information from Sining Fu of the intention of some Russians to enter our country, he began to collect his troops to oppose them." I still tried to convince the ambassador of our harmlessness. I explained to him how in all my four journeys, when I had traversed many lands and met many people, I had been everywhere received in a hospitable and friendly spirit, while here for the first time I was meeting with discourtesy and hostility on the part of the N'goloks.

But in spite of all my arguments, in spite of the fact that after the death in the preceding year of his wife—the sister of the then Gégén of Labran, who exercised a softening influence on her husband's character—Rinchin-sham had sworn before the Dalai-Lama at Lhasa to refrain from killing, and had ordered those under him to return home in a peaceful spirit, in spite of all this, he had no sooner reached his native valleys and hills, so often smeared with blood, than his desire for peace had evaporated. Next morning the prince's secretary did not put in an appearance at our camp, which caused us to indulge in mournful reflections, for in his non-appearance we were compelled to read the ill-will of the N'goloks towards us, and to recognize the possibility of a fight. Thus, sad to relate, we were unable to visit these particular nomads either on our journey south or on our return northwards to the Tsaidam. But the fragments of information which we were able to gather by questioning various individual tribesmen and their neighbours the inhabitants of Ja-chu-Kava will not be found altogether superfluous, as they throw a considerable amount of light upon that most interesting nationality, of which till a few years ago almost nothing was known.*

For how long the N'golok tribe has been in existence we were unable to ascertain. We were told that at one time Lin-gesur or Gesur-Khan had passed through their country, and that in the distant ages one of the Dalai-Lamas had cursed them. He is also supposed to have cursed another Tibetan tribe at the same time—a tribe living somewhere to the south near the Indian frontier—and for this reason neither of these would acknowledge his authority or accept his faith (Buddhism). To this day the curse is supposed to hang over the N'goloks, though they now are professedly Buddhists. They, however, do not acknowledge the

* Ja-chu-kava is the western portion of Dérge, one of the largest districts in eastern Tibet, through which the expedition passed on returning to the Tsaidam from the Lkhado district. All the inhabitants of Ja-chu-kava are nomads, who live in the upper Ja-chu or Yalun-tsyen, a tributary of the Blue river, and are the N'goloks' nearest neighbours on the south-west.

authority of the Dalai-Lama any more than that of China. If they rob any one, or if some one steals their cattle, they assume the most arrogant attitude in the subsequent negotiations, which they preface by saying, "You cannot compare us N'goloks with other people. You"—to whatever Tibetan they may be addressing—"obey the laws of strangers, the laws of the Dalai-Lama, of China, and of any of your petty chiefs. You are afraid of every one; to escape punishment you obey every one. And the result is that you are afraid of everything. And not only you, but your fathers and grandfathers were the same. We N'goloks, on the other hand, have from time immemorial obeyed none but our own laws, none but our own convictions. A N'golok is born with a knowledge of his freedom, and with his mother's milk imbibes some acquaintance with his laws. They have never been altered. Almost in his mother's womb he learns to handle arms. His forbears were warriors—were brave and fearless men, even as we to-day are their worthy descendants. To the advice of a stranger we will not hearken, nor will we obey ought but the voice of that conscience with which each N'golok enters the world. This is why we have ever been free as now, and are the slaves of none—neither of Bogdokhan, nor of the Dalai-Lama. Our tribe is the most respected and mighty in Tibet, and we rightly look down with contempt on both Chinaman and Tibetan."

The fact that the N'goloks plunder the Gégéns and vanquish the troops of Bogdokhan is evidence that they really do not acknowledge the authority of either the Dalai-Lama or of China. Five reincarnated followers of Daranata, proceeding towards Lhasa with an escort of Manchurians, were held up on the road and robbed by them, while most of the escort were slain. Some of these and the Mongol princes accompanying Daranata were actually obliged to return to the Tsaidam barefooted and hungry. Daranata himself succeeded in escaping earlier. The N'goloks frequently waylay caravans of pilgrims on the road to Lhasa and rob them of, as the saying goes, "their last shirts."

According to the Ja-Chu-Kava-ites, the N'goloks number more than 50,000 families, but we had no chance of testing the truth of what they said. Their statement, also, as to the strength of the N'goloks dwelling in the Archun district, on the banks of the upper Hoang Ho, must also wait upon the future for confirmation. The inhabitants of this Archun district, who call themselves N'golok-Archun Kaksums, are said to consist of about 26,800 families under seven leading chieftains. Of these, at present the most important is Norbu-dander, who was the highest in rank and possessed the greatest authority after the well-known and powerful N'golok family of Kangren-sen, now extinct. The number of families in Norbu-dander's own camp is 1000. In addition to this, he has under his command more than twenty other camps, and as the strength of each is computed at 100 families, they must contain altogether about 2000 families.

In the deceased Kangren-sen's personal camp, which used to be considered the biggest, there are computed to be 11,000 families; but as his authority also extended over fifteen other camps containing 2000 families, he may be said to have had under him some 13,000 families in all. Amongst the fifteen camps was the most western camp of the N'goloks, called Khorchi. We came across it on the march when near the river Serg-chu (a right-handed tributary of the upper Hoang Ho) on our return journey, and estimated its strength at 600 families.

Third in seniority of the seven chieftains comes Kansuir-sen, who has command of 1300 families contained in thirteen camps, in addition to 1000 families in his own camp. Next is Rinchin-sham, with whom we are already acquainted. In addition to his own camp of 700 families, he has control over four other camps with about 1500 families of Mongol-olots from the Koko-nor. Anchin-dops, the fifth chieftain, has command of 1600 families, of which 1000 are in his own camp and 600 in six

additional camps. Burfa-dander, the sixth, has also a camp of his own with 1000 families and fourteen other camps with 1400 families, i.e. a total of 2400. The seventh and last of the principal chieftains is Bamam-bum. He has 1500 families in his own camp, and 800 families in eight additional camps. Total under him 2300 families. From this it will be seen that there are altogether a total of some 26,800 families under the command and jurisdiction of the seven principal N'golok chieftains.

But besides these leading chieftains or princes, whom in importance and significance the N'goloks compare to the Tsin-tsais of Sining-Fu and Lhasa, each camp is commanded by a secondary chief, who is in fact a camp commandant. Their appointments, like those of the principal chieftains, are hereditary; but all chief tains, whether principal or secondary, reserve to themselves the right to select and appoint their own assistants. Matters of importance are decided in council by the seven principal chiefs. The junior chiefs, i.e. the commandants, deal only with trivial questions, and report what they are unable to deal with to whichever of the seven they may be under. The four principal chieftains—Norbu-dander, his brother, who now occupies Kangrensen's place, Kansuir-sen, and Rinchin-sham—have exceedingly nice houses close to one another on the frontier of the agricultural and the nomad population of the N'goloks of Archun. We were told that all seven chieftains insist on a very strict etiquette being observed with regard to themselves; none of their subjects being permitted to bother them on any unimportant matter, while no one is allowed to see them without previously asking for an interview, etc. They live either in their fine buildings of stone, clay, and wood, or else in tents, or in Mongol huts called "urgos." Once a year each of the camps sends to its principal chief a valuable offering, but what it generally consists of we were unable to ascertain.

A third of the population of the Archun district are tillers of the soil, and live year in and year out on the banks of the Ma-chu, or Yellow river, extending as far as Ruirchja-gomba. The remainder are alternately nomad shepherds and highway-men. A legend is told amongst the N'goloks, and also everywhere in Tibet, as to the origin of their military spirit, and the reason for their success in war or on pillaging expeditions. The story is that when journeying through Archun, Lin-gesur lost his wonderful knife, and searched for it without success, and it is to the presence of this knife in their country that the warlike ardour of the N'goloks is to this day attributed. However, apart from this, their continued success, and the way in which they have been able to guard their riches, are also ascribed to the sacred mountains of Amne-machin, otherwise known as Machin-bumra. The latter is probably the real name of one of the highest peaks in the eastern part of the Ame-machin range, a peak which is washed by the river Ma-chu on three sides. It is exceedingly high, and abounds with massive glaciers, which in the sun or by moonlight are a most beautiful and singular sight. In summer the N'goloks offer sacrifices and hold services on the Machin-bumra, where are many small monasteries. It is held so sacred that no N'golok will eat food either at home or on the march, or will set out on a raid, without previously casting as an offering some portion of food towards the mountain and muttering a prayer.

Every N'golok is a thief and robber; but they only steal from strangers, and never rob each other. If by any chance they do, the severest punishment is inflicted upon them, even though the value of the article stolen be infinitesimal and the crime be committed many thousands of miles away. A thief caught in the act has both his eyes put out, his hands cut off, and the tendons of his heels cut to prevent him walking. If a thief is discovered in camp, the camp commandant takes the criminal before his senior chief. He himself has not the power to punish

him. A N'golok found harbouring or assisting a thief is punished as if he himself were one. If it is known that a N'golok intends leaving his home and joining another tribe, he receives the same awful punishment as a thief. When starting on a pillaging expedition, or to hold up some wretched travellers on the great Lhasa caravan road, they are not obliged to ask permission from their chief. And if the expedition fails, or a number of them are killed, he does not call them to account. If they return laden with the spoils and with cattle, etc., their chieftain, whether one of the seven or only a junior chief, is presented with the best pony, a yak, or the best of the booty, though only a little may have been secured.

But to return to the interrupted story of the expedition.

Soon after the last of the N'goloks had passed our camp the valley of the Oring-nor was deserted. Instead of being alive with nomads, there prevailed that extraordinary stillness noticeable in so many parts of Tibet, and the presence of our tiny solitary camp among the mighty mountains seemed a fairy tale. How well I remember our camping-ground * on the shores of that beautiful lake so high among the lofty mountains—those dark blue or greenish waters with their edge so prettily scalloped out into bays by the steep high-banked promontories which here and there cut deep into the watery expanse! I can see before me now the beautiful foam-flecked waves ceaselessly beating against the shores with a monotonously recurring murmur, and the mirror-like transparency of its waters reflecting the high banks as well as the errant cloudlets gliding across the azure sky.

We were compelled to double the number of men on duty at night, to issue to every one the full complement of cartridges, i.e. a hundred, and to sleep without undressing, with our rifles beside us. In addition to our Mongols, whose sharp eyes were much more useful than glasses for spotting the parties of N'goloks who daily watched us from the eastern heights, two armed cossacks or grenadiers invariably escorted the cattle when put out to graze. Taking ordinary precautions, however, we often made excursions round about, shooting different animals and birds, while those of us who were in camp and not on duty spent their time fishing. There are an enormous quantity of fish in these lakes. Except by white-tailed eagles, fish-hawks, cormorants, and gulls, these waters had apparently never been fished, and our expert anglers were, in consequence, often rewarded with huge bags. The luckiest of all in this respect was Laduigin, who in about half an hour landed ten *Schizopygopsis thermulis*, *Sch. malacanthus*, each weighing from 3 to 5 lbs. I often watched them in the wonderfully clear water. They were most interesting in their native element, and to me it was more enjoyable to watch than to catch them. Most of the fish and cud chewing mammals which we killed were slain purely for the purpose of stocking our larder.

We soon got to know the ground, so I determined to push on with the map-work and to collect information about the two lakes of the upper Hoang Ho, which had been already visited by Prjevalsky when passing along the southern side of this basin. Having cautioned the party as to our relations with the numerous brigand tribe and its proximity to us, I risked leaving the camp for a few days. The personnel of my expedition consisted of Kaznakoff, two grenadiers, two cossacks, and two natives—a Mongol and the Tangut. We all rode our ponies, the baggage being

* On arriving at the lake we pitched camp on the left bank of the Ma'chu, where it runs out of the lake. On the departure of the N'goloks we moved across to the right bank, opposite our former camp. Part of the baggage was taken across in our boat, the remainder being brought across by the animals through a ford lower down, where an island divides the stream into two broad channels. Besides being more isolated, this bank appeared to us more convenient, because of its excellent grazing-land both by the edge of the water as well as on the higher ground along the eastern shore.

carried on camels. I purposely took this number, as it enabled us to split up into two independent parties. The object of the trip was to sketch and examine the western shore of the Oring-nor, as well as the stream flowing from the south-east corner of the upper lake into the south-west corner of the lower. Kaznakoff's work was in prolongation of mine, i.e. to go round the Jaring-nor (or Tsaring-nor) lake, from where this stream runs out of it, up along the eastern and northern shores to where the Soloma or upper Hoang Ho runs into it, soon after its rise on the "Starry steppe" of Odon-tala. We were both successful. I returned to camp on the fourth and Kaznakoff on the seventh day. After our return we were fortunately able to fix astronomically the geographical latitude of the point whence the Yellow river flows out of the Oring-nor.

The lakes of the upper Hoang Ho, the Oring-nor and the Jaring-nor, according to most Mongols, or the Tsare-nor (the lake of clear water) and the Tsake-nor (the lake of transparent shoals), as the Tsaidam Mongols call these waters, are known to the nearest Tibetans as the Tso-khnor and the Tso-khchar, and to us Russians as Lake Russian and Lake Expedition, the names given to them by Prjevalsky. Both these fresh-water basins, which are only separated from each other by a hilly isthmus some 10 versts broad, are 13,900 feet above the sea. The eastern, or Lake Russian, is about 120 versts in circumference according to its bank measurements, while Lake Expedition measures scarcely 100 versts. Both are bounded by high rocky shores, which in places take the form of narrow promontories cutting into the water. The rocks are generally composed of clay sandstone akin to clay-quartz schist, and here and there of limestone, though we found in the north-western corner of the upper lake large pieces and rocks of granite. The bays are separated from the principal or running waters of the basins by flat necks of land or isthmuses which separate little lakes generally of salt water. There are islands in both. Judging from the lowness of the water, and the ease with which shoals can be seen on a clear day, the upper lake is shallow, especially on the western side, where islands jut out of the water as if no part of the promontories of which they really form the ends. Between these promontories and islands, as also across the lake on the southern shore, wild yaks can often be seen wading when wishing to avoid the long circuitous round by land. The lower lake is rather deep. According to measurements taken by Ladugin along its longer axis, it was 15 sajens deep at a distance of 10 versts south of the point where the Yellow river flows out. On the 23rd the temperature at the bottom ($7^{\circ}8$ to $8^{\circ}2$) was a little lower than on the surface ($8^{\circ}7$ to $12^{\circ}1$).

The colour of these clear waters was greenish-blue or dark steel, varying according to the light and the clouds. When there was a south wind the waves on the lower lake assumed massive proportions, and made an imposing noise beating against the shores. These, as well as the bottom, were flinty, although at the deepest part of Lake Russian there is a quantity of red slime, in which, according to K. C. Merejkovsky, there were numerous different well-known diatoms. The breakers washed up a quantity of seaweed, which formed quite a high wall along the shore of the upper lake. Both lakes are connected by a stream of running water, which flows, as has been remarked before, into the south-west corner of the lower lake. It is about 15 versts in length, and has a width varying from 15 sajens to as much as 50 sajens, in places where it splits up into a network of branches. Where it has only a single channel the breadth does not exceed 30 sajens. During our stay the water was yellowish, and drained off rapidly into the lowlying marshy shores, the muddy colour intermingling with the water in the lake. Red slime was plentiful, and the water was in consequence shallow and full of weeds. Our collection of fish was enriched during our stay here by the following specimens:

Platypharodon extremus, *Gymnocypris leptcephalus*, *Nemachilus Stoliczkae*, *N. Kungeanus*, *N. robustus*.

The littoral is generally hilly save for two flat, broad valleys closing in on the northern shore of the upper lake, and disclosing to the north a view of the distant chains of mountains, the Munku-tasato-ula and Khatuin Khara. The lower lake is open on its north and south-western sides. The streams Jaghuin-gol and Razboynik (brigand) add to the running waters, or more properly to the adjacent swamp, by flowing into it from the south. The more northern stream which can be seen on old maps, forcing its way through a hilly neck of land of schist and aplite, in reality does not exist. Vegetation in the sense of pasture is plentiful along the shores, and animal life is visible on every side. During my trip round the shore I shot eight bears, one of them a she-bear with two cubs, while Kaznakoff killed an enormous old one. Of smaller animals we secured two specimens for the collection, a marmot and a *Canis Eckloni*. While camped here the weather was remarkable for the cloudiness of the sky and the quantity of atmospheric deposits which visited us in the shape of hail, snow, or rain. When the sun shone its rays were noticeably warm, especially in the absence of wind; but breezes blew daily, usually in a north-to-south direction. The atmosphere was very transparent.

Ivanoff, accompanied by three * of the natives, left us on June 25 to return to the Tsaidam. He took with him the boat, as well as our post for Russia and the collection of skins, etc., etc., which we had amassed among the hills. Having seen him safely off upon his return journey, we commenced to make our preparation for the onward march, not eastwards as before, but southwards into Kam. On the night of June 26, the evening before we left, a tremendous thunderstorm came from the south-west. Occasional and deafening claps of thunder shook the air. Streaks of fiery lightning snaked fantastically through the inky darkness of the night, at times brilliantly lighting up the wide expanse of water in the lake. The towering foam-flecked breakers, chasing one another in vain hot haste, dashed noisily against the irresponsible shore. And so it continued all night long, save that a heavy snowstorm joined the frenzied elements, covering the adjacent hills with a white shroud. At sunrise all was still, except the majestic waters fretting, blustering, and vainly raging. Having forded the Hoang Ho below where it issues from Lake Russian, the caravan bore south-west along the isthmus, behind which was hidden the western or upper lake. We revelled daily in the beautiful view on the eastern lake, more especially when we had to climb over high-lying ground abounding in grassy vegetation. What with fish jumping in the water, cormorants swimming about, to say nothing of gulls, white-tailed eagles, etc., etc., we ran no risk of being dull or requiring amusement on the road. Parties of N'goloks were constantly watching us, showing themselves sometimes close and sometimes at a distance. Dadai amused us by telling fortunes—telling our cossacks, for instance, that some N'goloks would soon come into sight, that a khainik would fall sick, or that on the following day the chief of the party would kill a bear. On the fourth day we crossed a tributary of the Jaghin-gol, and after passing the memorable spot where the N'goloks made their first attack on the expedition of my never-to-be-forgotten teacher, we pitched camp.

After leaving the lakes we proceeded up the Jaghin-gol, every now and again crossing from one bank to the other. During its course this stream is in no way inferior to the newly risen Hoang-Ho, which it joins as the latter emerges from the upper lake. Including its bends and curves it is about 150 verstas in length. High

* Two Tsaidam Mongols and the Tangut guide, who was to leave them in the lower part of the Alyk-noring-gol.

up it follows an easterly direction, but lower down it inclines to the north-east. In places it flows through valleys and breaks up into branches, while in others it is squeezed into a narrow bed by overhanging banks and ridges, which close in on it with their sandstone rocks. Where narrowed by the hills its waters bowl madly onwards, and the stream is quite unfordable, but where it widens out the depth does not exceed 3 or 4 feet. In the rainy season the water is twice as high, and, leaving the river-bed, overflows the banks on to the adjacent lowlying ground. Like the valley of the upper Hoang Ho, that of the Jaghin-gol was covered with feather grass (*Stipa orientalis*), similar to the bristles of a beautiful brush, amongst which could be seen the *Przewalskia tangutica* already flowering. In broader parts there were considerable strips of *Cobresia tibetica*, a characteristic attribute of Tibetan plateaus. Lower down and along the sides was the lychnis, *Adonis cœrulea*, euphorbia, astragalus, with beautiful violet flowers, and occasionally the hedsyrium. But more lovely than anything else were the magnificent pink flowers of the *Incarvillea compacta*. On the hills were dwarf gentians, blue and white, straw-coloured pedicularis, large dandelion, and amongst the rocks the fern-like *Potentilla fruticosa*, and many other plants. The mammals in these parts were the same as in the other hills, the only difference being the quantity of this or that species. We saw more herds of wild yaks than any other animal in this locality, and we killed a number of them for the larder.

Those who are travelling in Tibet for the first time, as well as old hands, find it very difficult not to spend much of their time studying animal life and to be continually shooting. Wild yaks afford the most enjoyable sport. I should mention that the large herds are much harder to approach than single beasts or small groups of them. The largest bulls seldom travel with the big herds, generally keeping to themselves. If one wishes to kill the young ones, one should follow a herd and pick one's shot. The big old bulls are to be found only in the dark nullahs. Shooting yaks, in fact, is little different to shooting any other animals, but, independent of the numbers of animals in the neighbourhood, sport requires both time and knowledge, or what sportsmen call skill, and climbing the hills requires strength and endurance. Owing to the quantity of work which there always was in camp, I personally rarely went out shooting, save when we were making a prolonged halt, as in Gan-su or Kam, and accordingly when an interesting animal in the shape of a bear or a yak came close to our camp, or near us on the morning's march, I never missed an opportunity of shooting it. Before entering the Jaghin-gol valley we had seen a number of wild yaks, but only at such a distance as to make it impossible to go after them, and we were all most anxious to try the destructive power of our new "three-line" rifles on this the biggest of the animals in Tibet. The Jaghin-gol valley, where we were more than ever in need of meat, and where we saw more wild yaks than ever, seemed to give each of us a chance of firing at, if we did not kill, the "bukhu-guresu," as it is called by the Mongols.

One early morning, soon after entering the valley, when the caravan was on the march and skirting some high hills, which fell away in numerous spurs, I suddenly came on a group of wild yaks on the slope of one of these spurs. Having scented us, the beasts became alarmed and quietly began to move off, but one old bull quickly turned in our direction, and, after advancing a few steps, stopped, apparently undecided as to what to do. We could see at once, from the fighting way in which he carried his head, from the glint of his eye, and from the way he raised his shaggy tail, that he was angry and meant war. Slipping off my pony, I went down on my knee and opened fire on the great brute. The fourth shot brought him down, rolling over on the slope. After a minute or so he raised himself up on his fore legs, but his hind quarters dragged behind him, as his spine was broken. Though

helpless, the huge brute was mad with rage. His blood-shot eyes rolled round, his fore legs pawed the ground, and, moving his head, he looked as if he meant charging and crushing us with his massive carcass. But he was mortally wounded, and, to put an end to his suffering, I again fired at him. It took three more bullets before he fell and breathed his last. The destructive effect on animals of the new "three-line" rifle is wonderful. The bullet breaks up bones to small pieces, tears through muscle and membrane, and the more compact they are the greater the penetrating effect. We calculated that, as regards death-dealing capabilities, five or six of its bullets were equal to ten of the Berdan rifle.

In addition to wild yaks, quantities of koulans were seen in the Jaghin valley, as well as a number of antelopes, which appeared generally to fall a prey to the wolf. Tibetan bears were to be found wherever the *Lagomys laducensis* lived, and our collection was enriched by the skins of many of these animals—skins of all sizes and shades of colour from light to dark, and we seldom found such a variety among other animals.

It rained continuously during the time we were in this valley, stopping only occasionally in the morning, when the caravan had to do its usual long march of perhaps 15 versts. At night or towards morning the temperature used to drop to 3°·8 below zero, and hoar-frost covered the ground.

It is wonderful to what extremes of climate plants are impervious in their struggle for existence. With the rise of temperature by day they open out. At night, and in cold weather generally, they seem to go to sleep. It is difficult to believe that in a valley of north-east Tibet, on the same day in June, and in the same place, travellers can see winter all around, and yet in the middle of the same day, or perhaps a little later, they can look on a summer scene. Snow which falls at night paralyzes vegetable and animal life for some hours. The ground is covered with snow; creeping things hide in their burrows. Jays and finches (*Pyrgilauda rust-collis* and *Onychospiza Taczanowskii*) are not to be seen. One hears neither the voices of larks nor the humming of insects, as if everything had disappeared—had died. But the moment the warm sun begins to peep through the clouds, the snow melts, green patches little by little begin to appear, plants raise their heads and their flowers open; creeping things come out of their holes, finches and jays fly out, beetles, bumble-bees, and other insects crawl forth, and, in a word, nature comes to life again. The medium-sized and large mammals in the Tibetan hills are sufficiently protected from climatic discomforts by thick long wool. This is especially noticeable among the largest animals—the wild yak, for instance, which has on its belly a mass of shaggy hair which with those sort of beasts serves the purpose of bedding or a rug.

During the rainy season, or it would be more correct to say the rainy and snowy season, our tents, felt, and baggage generally got soaked through and through with the damp, the surface of the ground was greasy mud, and our boots soon wore out. The lower ranks of our party, in particular, had a very rough time of it, and the worst duties were those of escorting the animals while grazing, or of cooking, and of the men on duty at night. Cooking the early morning tea was one of the most distasteful and difficult jobs, for the efforts of both reliefs* were required in order to get the kettle or teapot to boil on the wet yak-dung fuel. The first relief did his best to dry the fuel, while the other busied himself continually with the bellows, trying to keep the fire up. But, as the most important and dangerous hour for a sentry is early dawn, when Tibetans, like all other Central Asian tribes,

* By night our sentries were divided into two reliefs. The first relief till midnight, the second till dawn, when we usually struck camp.

attack, there was generally another of us awake to assist in boiling the tea, namely, one of the non-commissioned officers, Teleshoff or Jarkoy. The reader can imagine what difficulties we experienced in this weather with the natural history collection, especially with the plants, which require dry, fine weather. Our arms rusted badly, and required constant cleaning and attention.

One of the tributaries on the right bank of the upper Jaghu-gol brought us out on to a soft grassy pass, called the Chjabu-vrun, which is 15,170 feet above the sea. This ridge is called the watershed of the Yellow and Blue rivers, whence to the north and west the hills of Tibet fall away in huge undulations. To the south the contrast is very great. There one saw successions of deep nullahs, while in the distance the proudly towering peaks of the snowy Hatu-chu formed a perfect picture against the blue background of the heavens. No sooner had we crossed into the basin of the Blue river than Nature seemed literally to fawn upon us. The climatic discomforts which we had so lately endured became a thing of the past. Every day, as we descended along the nullah, the weather became milder, and the general view of the country was a pleasant relief to the eyes. Our herbarium and entomological collection grew apace, for everywhere around us the ground was carpeted with variegated plants, above which butterflies (*Parnassius*) fluttered, and from flower to flower of which flew bees, wasps, bumble-bees, and many other insects, disturbing the silence with their humming. In the noisily tumbling transparent waters of the brooks were fish—*aphua* (*Nemachilus bombifrons*) and *Schizopygopsis thermalis*, while in the hilly glades close to the banks we discovered an interesting new species of *Microtus Kaznakowi*. But the large mammals common to the mountains seemed to have disappeared—squeezed out, in fact, by man, the northern Tibetan, whom we were soon to meet. The first inhabitants of the country whom we encountered along the banks of the Khi-chu stream were northern Tibetans of Namtso's camp, who had previously heard from Sining Fu of our probable entry into their country. As soon, therefore, as the sons of the absent old chieftain learned of our arrival, they ceased reviewing the warlike preparations of their subjects and galloped to our camp to meet us, accompanied by Badmajapoff and Dadai, whom we had sent to them, and by fifty of their fully armed warriors. It did not take us long to make their acquaintance and to establish friendly relations. The eldest son of the "bey-khu," in his father's absence, apologized profusely for not meeting us on the top of the pass, but excused himself by saying that he had not heard of our arrival. Both sons, and especially the elder, seemed extremely partial to alcohol, and willingly drank the brandy and vodka which we offered them. It was late in the evening ere they took their departure to their tents, some 5 versts lower down the nullah, previously promising to meet us early next morning near their camp, to prepare an open piece of ground for our tents, and to allow us the use of their father's grazing-grounds.

They were true to their words. We were met next day near their father's camp by the elder son, looking rather the worse for his strong refreshment of the previous night, and we pitched our camp hard by. The broad nullah was capable of accommodating many people. Everywhere, both up and down stream, the place was black with tents, and on the outskirts were numerous herds of domestic yaks, sheep, and other cattle belonging to the chief. Here and there rode lightly armed horsemen, or there passed a caravan of yaks, laden with the household goods of nomads changing ground. Occasionally mendicant wandering lamas passed and pitched camp, their white tents standing out sharply against the others, showing clearly to whom they belonged, who the owner was, and why he had come. The sound of tambourines, horns, and penicils were often to be heard in these moving chapels, especially in the evenings.

That day, July 16, as we were making a halt, Kaznakoff and I, accompanied by Badmajapoff and Dadai as interpreters, and guided by the chief's elder son, set out to call at the house of their absent father. Entering the large, roomy, and comfortable tent, which was divided into two parts, one reserved for the guests, and one occupied by the women and household accessories, we took our places. Opposite us smoked a huge fireplace, with projecting sides, on which were some eight copper or iron pots of different calibre. The cook and mistress were busily occupied at the fireplace. They were assisted by the latter's young daughter, whilst a servant was making butter in some large tubs. After the well-known ordinary welcome, we were offered tea and "juma," and, afterwards, liberal portions of mutton from a sheep which had been especially killed in our honour. The eldest son of the "bey-khu" waited upon myself and my assistant, while his secretary attended to the wants of our interpreters. Neither the mistress of the establishment nor her daughter stopped looking at us from the moment of our entry till our departure. Having tendered our thanks for their hospitality, we took our leave, but not before the eldest son presented us with a fox and other gifts usually offered to an honoured guest.

(To be continued.)

STEREO-PHOTO SURVEYING.*

By F. VIVIAN THOMPSON, Lieut. R.E.

I. THE OBJECT AND USES OF PHOTOGRAPHIC SURVEYING.

THE object of photographic surveying is to map the detail of a triangulated area at a minimum expenditure of time and labour in the field, and at a total cost so far below that involved in plane-tabling as to warrant the sacrifice of that high degree of accuracy attainable in good plane-tabling. From this it might appear that photographic surveying is necessarily less accurate than plane-tabling. This is not the case; but, to attain the same degree of accuracy in detail, so many plates would, in certain classes of country, be required, and the plotting would be so tedious, that the photographic method might be less economical than plane-tabling.

One of the chief reasons why photographic surveying has not proved more popular in the past is that the method has been wrongly applied, and attempts made to compete with the plane-table or the chain in large-scale work. The economical advantages of the photographic method over plane-tabling increase as the scale of the map decreases, and as the ruggedness and general steepness of the country increases. These two conditions, viz. scale and nature of the country, must be carefully considered before a photographic survey is embarked upon. Atmospheric conditions require less consideration, the balance being slightly in favour of photographic surveying in most countries, if a stereoscopic method is employed. Generally speaking, a small-scale contoured map in mountainous country of 2 inches to 1 mile or under, and of sufficient accuracy for all ordinary purposes (military operations included), would be most economically turned out by a photographic method. The time occupied would vary from one-fifth to one-tenth of the time occupied in plane-tabling the same area, and the cost would vary in approximately the same proportion.

Plane-tabling is necessarily slow, but thorough. To compete with the camera the plane-table must hurry, and hurried plane-tabling could not compare with the work plotted from photographs. In very hilly and precipitous country everything

* Research Department, February 21, 1908. Map, p. 588.



FIG. 1 —THE STEREO-FLOTTER. THE LETTERING REFERS TO FIG. 10.

is in favour of the camera, and here the degrees of accuracy would differ very slightly. In many large tracts of country financial considerations render a detailed plane-table survey out of the question, whilst political or natural considerations may render it unnecessary; but in most cases a small-scale contoured map is desirable, and in such cases the photographic method is the most economical way of obtaining it.

Other cheap methods have been tried, such as combined reconnaissance sketches executed with plane-table or sketching-board, and pieced together by means of a graphic triangulation or other makeshift. In many cases a photographic survey, run concurrently with a rapid triangulation, would probably have proved less costly and have given a more satisfactory result. The stereo-photographic method should prove particularly useful in exploration work, railway reconnaissance, colonial and frontier surveys on scales of 2 inches to 1 mile and under.

The photographic work to be done in the field has been made quite systematic, and requires very little skill; no focussing is required, and each exposure is determined by means of an actinometer. Development of plates is carried out by time. It should be easily mastered by any surveyor after a few weeks' practice. For the use of travellers and explorers the method is peculiarly suitable, as no technical knowledge of surveying is required, and any one with a fair eye for country could expose plates from which results could afterwards be plotted equal in value to a standard of plane-tableing which it might take him many years' training to attain. Another great advantage from the explorer's point of view is the small amount of time occupied in taking the views, and the extensive tracts of distant country that can be swept in from a single station. By using a suitable combination of lens, colour screens, and plate, any distant point which can be seen with the naked eye can afterwards be plotted from the resulting negatives. In this way the photographer knows exactly how much detail he may expect to obtain in the plotted results.

The feasibility of economical photographic surveying is entirely due to the state of perfection which the manufacture of orthochromatic plates and colour screens has reached during the last few years. B. J. Edwards's medium isochromatic plates were used in the Cumberland work, and are also used in Canadian surveys. The amount of detail, sharpness, and contrast compared with that obtainable on an ordinary dry plate is almost incredible. The results are too bright and the contrast too great to give an artistic effect, and for this reason orthochromatic plates and dense orange screens are seldom applied to landscape work in ordinary photography. Hence little is known of its capabilities. Climatic effects on modern orthochromatic plates are reduced to a minimum with ordinary care in packing.

Figs. 2 to 5 show four reproductions, each of which is one of a pair of stereoscopic views employed in plotting the map of the country south of Keswick (see pp. 538, 539). Contact transparencies were used, and naturally gave much more detail when magnified six times than can be seen in these reproductions.

A great amount of time and money is spent each year by explorers and others in taking photographs of unmapped country. With a very little extra expenditure in time and still less in money, better views might be obtained, and, in addition, the material for a contoured map of all the country appearing in each view, probably several square miles in extent, could be made available, and this without moving more than a hundred yards. Unique opportunities are probably missed in this way. The camera outfit would cost no more than an up-to-date Reflex camera; the additional weight would be small. Some central organization at home would be required for plotting the results. This could be done economically by a plotter and plotting machine attached to any existing photographic establishment, where plates could be developed and transparencies prepared.

II. PREVIOUS PHOTOGRAPHIC METHODS.

The method of photographic surveying employed hitherto has in most cases been identical with, or some slight modification of, the method employed by the Canadians in the Dominion Lands Survey, and described at length in 'Photographic Surveying,' by E. Deville, Surveyor-General of Dominion Lands (1895).

Theoretically, the accuracy of the Canadian method is considerable, but as the method is one based on intersections, each point, before it can be plotted, must be identified in at least two views taken from points a considerable distance apart. This necessitates either much forethought in the field, or a prohibitive expenditure in plates and time. The identification of similar points and the subsequent plotting are most tedious. In spite, however, of these difficulties and the high standard of training required for the economical selection of views in the field, the Canadian Government has turned out admirable maps of the Rocky mountains by this method. It is estimated that the cost of a photographic survey under their conditions is less than one-third the cost which would be incurred in plane-tableing the same area.

III. STEREO-PHOTOGRAPHIC SURVEYING.

This method was first worked out on a practical basis by Dr. Pulfrich in 1903, but was suggested by Captain E. Deville some years previously (*vide Transactions of Royal Society of Canada*, 2nd series, 1902-03, vol. 3, sect. III., "On the Use of the Wheatstone Stereoscope in Photographic Surveying," E. Deville; also Dr. C. Pulfrich, "Über eine neue Art der Herstellung topographischer Karten und über einen hierfür bestimmten Stereo planigraphen," *Zeitschrift für Instrumentenkunde*, Heft 5 (Mai), 1903, xxiii. Jahrg.). Concurrently with Dr. Pulfrich, who is a member of the scientific staff of the Carl Zeiss Werke, Jena, Mr. H. G. Fourcade has been working in South Africa at a modification of the same principle (*vide Journal of the Institute of Land Surveyors of the Transvaal*, No. 6, vol. 1, 1907).

In outline, the stereoscopic method consists in taking photographs in pairs, in the same vertical plane, at a measured distance apart, and viewing these negatives, or positive transparencies made from them, in a special form of stereoscope. The eye-pieces of the stereoscope are provided with exactly similar indices, which can be made to combine stereoscopically with any given point in the view by increasing or decreasing the distance between the slides holding the photographs. The amount of separation required for stereoscopic combination is a measure of the range of the point from the plane in which the plates were exposed, and can be read on a suitable scale. Azimuth and elevation or depression can also be read from scales on the instrument, thus completely fixing any desired point in the view.

The following is a brief explanation of the method:—

In the first place, the photographs of the country to be mapped must be taken in pairs, so that they may be viewed in the stereoscope, which is a part of the plotting apparatus. The ordinary stereoscopic prints seen are, of course, taken in a camera provided with lenses mounted $2\frac{1}{2}$ inches apart, which is the normal interocular distance of the human eyes. Consequently, objects situated more than a few hundred yards distant do not stand out in relief.

In photo surveying, where ranges of several miles may be required, a much greater range of relief effect is necessary. This is obtained by taking the two views from points, say, 300 feet apart. The effect seen in the stereoscope is precisely that which would be seen by an individual whose eyes were 300 feet apart, and is 1440

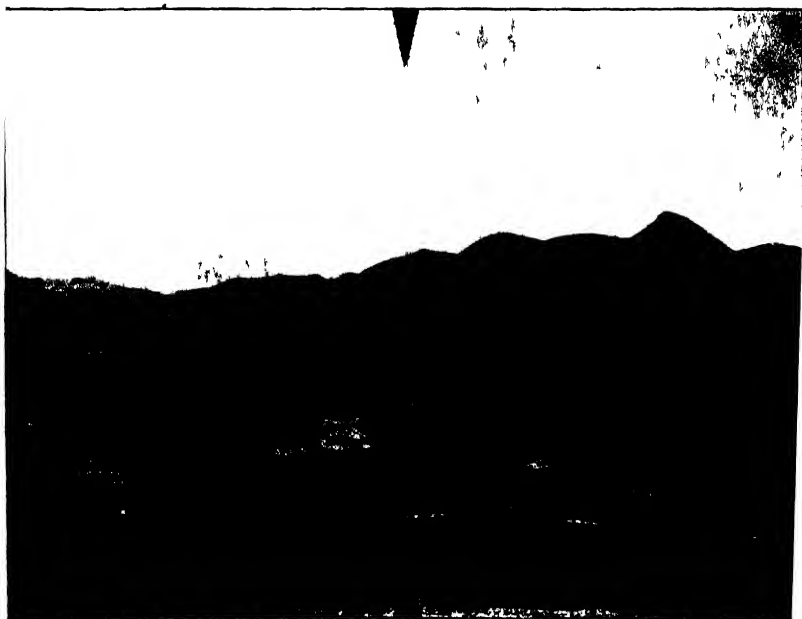


FIG. 2.—LOOKING NORTH-WEST TOWARDS KESWICK FROM NORTH.

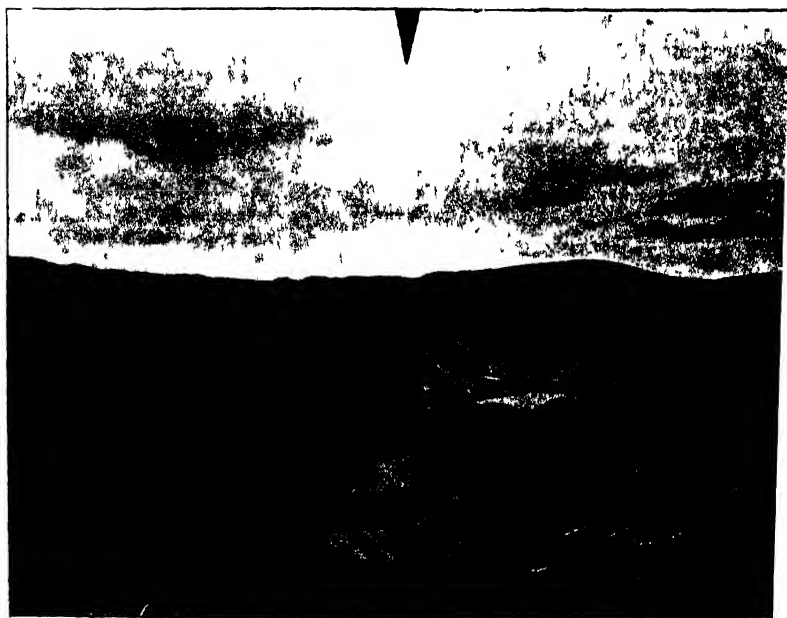


FIG. 3.—LOOKING WEST FROM CAT BELLS.



FIG. 4.—LOOKING WEST FROM GRANGE FELL.

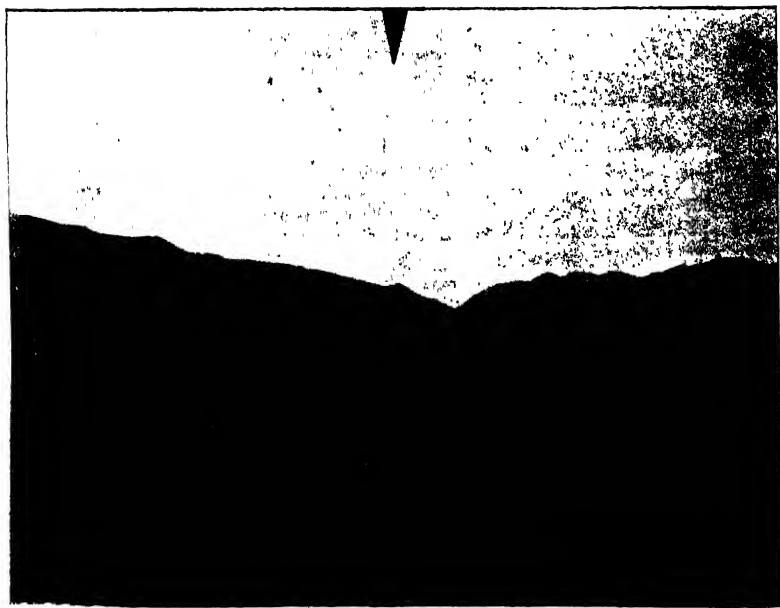


FIG. 5.—LOOKING NORTH FROM HILL, SOUTH OF STONETHWAITE.

times the relief effect seen by the normal eyes. The distance between the two view points is called the "stereoscopic base."

In order that accurate measurements may be made from the plates, it is essential that the two plates should be exposed in precisely the same vertical plane. Both views are taken with the same camera. Fig. 6 shows the arrangement employed.

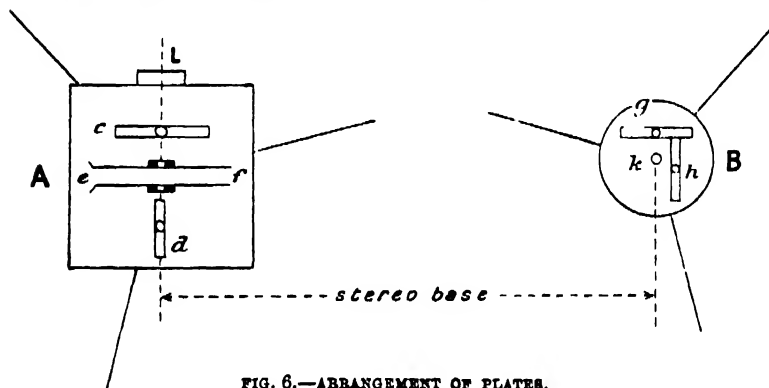


FIG. 6.—ARRANGEMENT OF PLATES.

A is the left-hand position of the camera, L is the lens, *c* is a small telescope provided with cross hairs, and mounted in Y bearings on the upper surface of the camera. The Y bearings are carefully centred and set so that the line joining the Y's is parallel to the axis of the lens. The telescope is collimated, and can be reversed in its bearings. B is a metal plate (sighting plate) provided with a small metal upright rod sight, K, about 6 inches high and quarter inch diameter, painted white on the lower half and black on the upper half. *g* and *h* are levels, and so adjusted as to exactly correspond with the levels *c* and *d* on the camera; consequently, if the camera and sighting plate are levelled and interchanged no further adjustment for level is necessary.

In setting up in the field the following procedure was adopted:—

1. Set up camera at left station and direct it to include the view required (angle of view marked by sighting lines on upper surface of camera).
2. Attach telescope and direct assistant, who has fixed sighting plate on to second tripod 200 or 300 feet away, till he is approximately on the correct alignment.
3. Complete levelling of camera and sighting plate, and bring cross wires of telescope on to sighting rod by slow-motion screw.
4. Make exposure.
5. Interchange camera and sighting plate, reversing telescope in its bearings to eliminate collimation in setting of the Y's.
6. Bring cross wires on to sighting rod by slow-motion screw.
7. Make second exposure.

The time taken in setting up, exposing, and packing up again varies from fifteen to twenty minutes under favourable conditions, and provided the base has not to be measured.

The measurement of the base, which would be done by a subtense method or by a stretched invar wire, would only occupy a few extra minutes, as no high degree of accuracy is essential, an error of $\frac{1}{100}$ being admissible in small-scale work. The two view points need not be at the same elevation,

C_1, C_2 are the two positions of the camera, separated by the known distance L_1L_2 , which is the "stereoscopic base." The axes N_1X_1, N_2X_2 are exactly parallel.

Geometrical explanation of the method

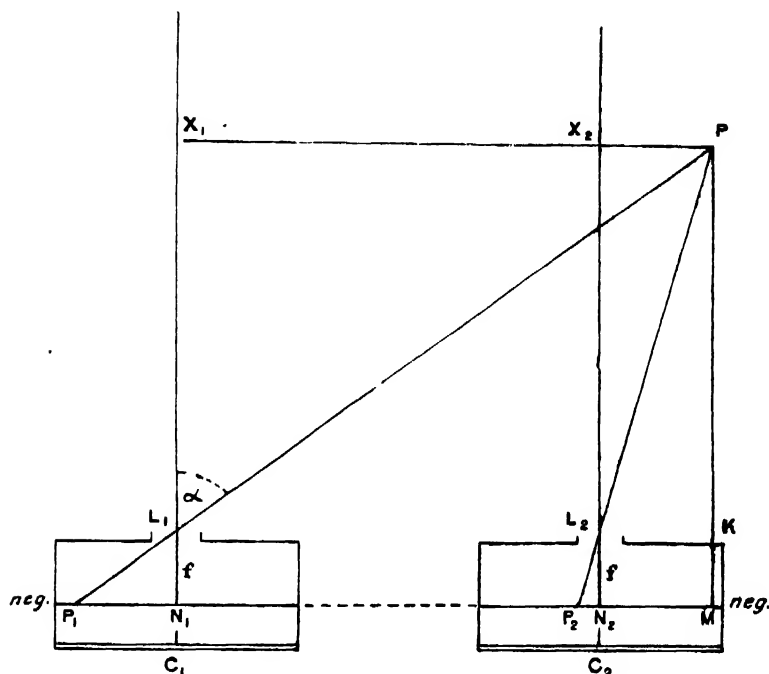


FIG. 7.

P is any distant point in the view. Images of P will be formed at P_1 and P_2 on the negatives N_1 and N_2 .

Then by similar triangles—

$$\begin{aligned} \frac{P_1N_1}{f} &= \frac{L_1K}{KP} \\ \text{and } \frac{P_2N_2}{f} &= \frac{L_2K}{KP} \\ \therefore P_1N_1 - P_2N_2 &= f \times \frac{(L_1K - L_2K)}{KP} \\ \text{or } P_1N_1 - P_2N_2 &= \frac{\text{focal length} \times \text{stereoscopic base}}{\text{projection of range on axis of lens}} \end{aligned}$$

Now, P_1N_1 and P_2N_2 can be measured on the negatives ($P_1N_1 - P_2N_2$ is called the "parallax" of the point P), therefore the position of P is determined. Similarly, by measuring the distance of P above or below the horizon line on the negative (say h), and knowing the projection of the range of P on axis of lens (say R), the height of P above or below the camera station = $\frac{R \times h}{f}$.

For convenience all measurements are made with respect to the left-hand camera station.

In practice these three measurements for—

- (1) Parallax,
- (2) Azimuth,
- (3) Elevation or depression

are reduced in the recently designed stereo-plotter to a single reading, viz. parallax. Azimuth and elevation or depression are automatically indicated.

Measurement by Stereoscopic vision.

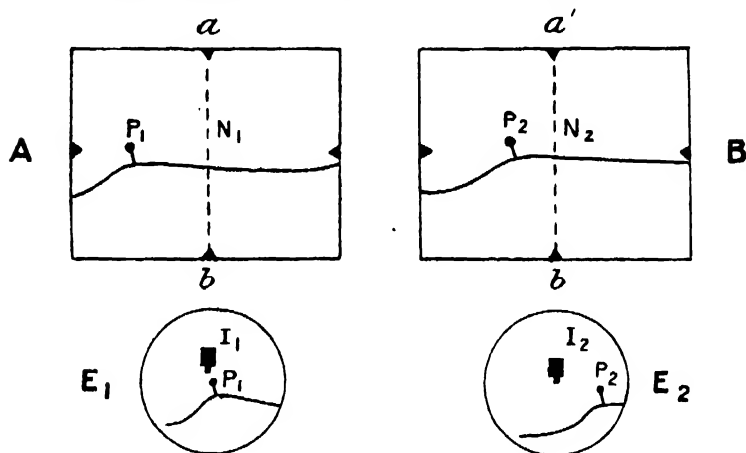


FIG. 8.

Fig. 8 shows the position on the plates of the point P in Fig. 7.

The four triangular reference marks on each plate are imprinted by projections on the inside of the camera. The plate is pressed against them during exposure, and since they are accurately set in the focal plane of the lens, all plates are exposed and marked in exactly the same relative position, and no focussing is required.

If we can measure $P_1N_1 - P_2N_2$, we have a measure of the distance of P from the plane of the plates. This measurement is effected by means of the stereoscope, in the eye-pieces E_1, E_2 of which are indices or marks, I_1, I_2 , made exactly similar in appearance.

The eye-pieces E_1, E_2 are carefully set and fixed at the interocular distance of the observer; the indices I_1, I_2 then "combine" stereoscopically and appear as a single index.

The negatives are now so adjusted, by using each eye separately, that their central or principal lines coincide with the indices in the eye-pieces.

If the negatives are now moved bodily, till, using the left eye only, the index in E_1 appears to touch any object P_1 in A, then on using the right eye only, the same object in B will appear somewhere to the right of the index in E_2 , unless the object were at an infinite distance, in which case it would coincide with the index.

Assuming the object selected to be at some intermediate distance, the effect transmitted to the eye senses on using both eyes, is that of an object standing out

in sharp relief (much exaggerated owing to the length of stereoscopic base used), with an index suspended in space at an extreme distance behind it.

If the right-hand negative B is now slowly moved to the left independently of the left-hand one A, the sensation conveyed is that of the index advancing from the rear, until, when B has been moved through the parallax distance $P_1N_1 - P_2N_2$, the index will appear to hang exactly over the object. This amount of parallax movement made is shown on a suitable scale.

Now, this movement of the right-hand negative through the distance $P_1N_1 - P_2N_2$, or the "parallax distance," has been shown

$$= \frac{\text{focal length} \times \text{stereo-base}}{\text{projection of range on axis of lens}}$$

Assuming the focal length and stereo-base to remain constant and equal, say 6 inches and 200 feet respectively, it is clear that the parallax movement can be expressed in terms of the projection of the range, and shown as such on the parallax scale.

E.g. suppose projection of range of P = 1000 yards,

$$\begin{aligned} \text{then } P_1N_1 - P_2N_2 &= \frac{6 \times 200}{1000 \times 3} \text{ inches} \\ &= \frac{1}{5} \text{ inch} \end{aligned}$$

Again, suppose projected range of P = 900 yards,

$$\begin{aligned} \text{then } P_1N_1 - P_2N_2 &= \frac{6 \times 200}{900 \times 3} \\ &= \frac{4}{15} \text{ inch} \end{aligned}$$

(*Note.*—Projection of range of P is the horizontal distance of P from the vertical plane in which the plates were exposed.)

In this way the parallax scale can be graduated in yards, and in this particular case a movement from the zero to a point $\frac{2}{3}$ inch away indicates a projected range of 1000 yards and a further movement of $\frac{1}{3} - \frac{2}{3}$ or $\frac{1}{3}$ inch indicates a decrease in range of 100 yards. A movement of $\frac{1}{1000}$ inch can be read, and $\frac{1}{2000}$ inch estimated on the drum.

It is obvious that instead of using both eyes at the same time the measurement could be made by using each eye separately to bring the objects into coincidence with the indices, but the double observation takes longer and is less accurate than a single stereoscopic observation when both eyes are used at the same time, the accuracy of observation being approximately 3 : 5.

In cases of abnormal vision where the stereoscopic accommodation is defective, the double observation would be necessary; such cases are not uncommon, and it is advisable to select plotters whose stereoscopic accommodation is well developed. Individuals are found to vary to a considerable extent in this respect.

Fig. 9 shows the principle of Dr. Pulfrich's "stereo-comparator."

O_1 and O_2 are the object lenses, and of such a focal length as to form images of those portions of the negatives *ab*, *cd*, immediately below them at *g* and *h* after reflection at the prisms P_1 , P_2 , P_3 , and P_4 . The indices (I_1 , I_2 , Fig. 8) are placed at *g* and *h*. Magnified images are formed by the eye-lenses E_1 and E_2 . Interocular and focussing adjustments are omitted in the figure.

The microscope may be considered as mounted on a bridge, *k*, which is rigidly connected with the base plate *mn*. The microscope can slide along this bridge in a direction at right angles to the plane of the paper, the amount of movement being shown on a scale S_2 (elevation and depression). ST is the main slide carrying the

negatives *ab*, *cd*. Its movement with respect to the base plate *mn* is shown on a scale *S* (azimuth). *RW* is the parallax slide slotted into the main slide; it carries the negative *cd*. Its movement with respect to the main slide is shown on a scale *S*₂ (parallax).

From a consideration of Figs. 7 and 8 it is obvious that the position in plan and height of any object can be plotted from readings of the three scales *S*₁, *S*₂, and *S*₃,

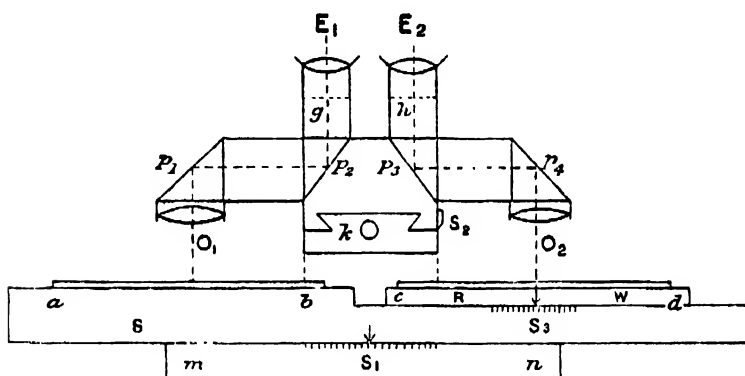


FIG. 9.—PRINCIPLE OF PULFRICH'S STEREO-COMPARATOR.

and corresponding settings on a detached plotting-board. This method of plotting is considerably more rapid than the Canadian method of intersections, but is not sufficiently rapid to enable a plotter to keep pace with a camera party.

The mental picture of the natural features in the neighbourhood of the point is apt to be lost whilst the three verniers are being read and scales are being set on the detached plotting-board.

THE STEREO-PLOTTER.

With a view to simplifying the method and increasing the rapidity of the plotting, experiments were carried out at the School of Military Engineering early in 1907, and an instrument designed which makes the plotting of points and the reading of heights nearly automatic. To distinguish it from the stereo-comparator it has been called a stereo-plotter, as it combines the offices of the stereo-comparator and plotting board. Mr. Conrady of Messrs. Watson & Sons, who was consulted in the matter, suggested many valuable improvements in design, and worked out with much care the optical and mechanical details. In this instrument the binocular microscope is of a similar pattern to that used in the stereo-comparator (Fig. 9).

The reading of the three scales *S*₁, *S*₂, *S*₃ is reduced to a single reading of *S*₂, which is a spirally scaled drum graduated in yards, and the three separate corresponding settings on a detached plotting-board are reduced to a single setting on a plotting-board which is part of the instrument. In this manner the chances of error in reading the scales are minimized and the speed of plotting very much increased.

Fig. 10 shows the stereo-plotter in its simplest form (see also Fig. 1). *MN* is the binocular microscope sliding in a direction *lm* or *ml* on a bridge (omitted in drawing), rigidly connected with the base plate. *N*₁, *N*₂ are the negatives. *N*₁ is

rigidly fastened to the main slide *abc*. *N*₂ is fastened to the parallax slide *de*, which can slide within the main slide.

The main slide *abc* is actuated by the handwheel *g*, and its motion transferred to the plotting-board by a screw shaft *gh* working in a sliding collar *k*. A stud or projection on *k* engages with and moves a radial arm, *rk*. As the main slide is moved, *rk* is moved correspondingly in azimuth.

The movement of the microscope is actuated by the handwheel *l*, and its motion transferred to the plotting-board by the shafting *lmn*, *mn* working in a sliding collar, *p*. A radial arm, *sp*, engages with a stud on *p*, so that as the microscope is moved up and down on the negatives, *sp* moves correspondingly from one side to the other, indicating elevation and depression.

The parallax slide *de* is moved by the spiral drum *f*, which is graduated in yards, showing projection of range on axis of lens for a given base and focal length. *wx* is a scale of yards set at right angles to *rk*, *wx*, *sp*.

If *rk* and *sp* are equal to the focal length of the camera lens, it will be obvious, from a consideration of Figs. 7 and 8, that when any object in the view is brought into stereoscopic combination with the indices in the eye-pieces of the microscope by turning *g*, *l*, and *f*, and when *tvu* is set at the range shown on *f*, then the intersection of *rk* with *tvu* gives the position in plan, and the intersection of *sp* with *tvu* along a suitable scale, *yu*, gives the height in feet above or below the camera station, which is represented by *r* in plan.

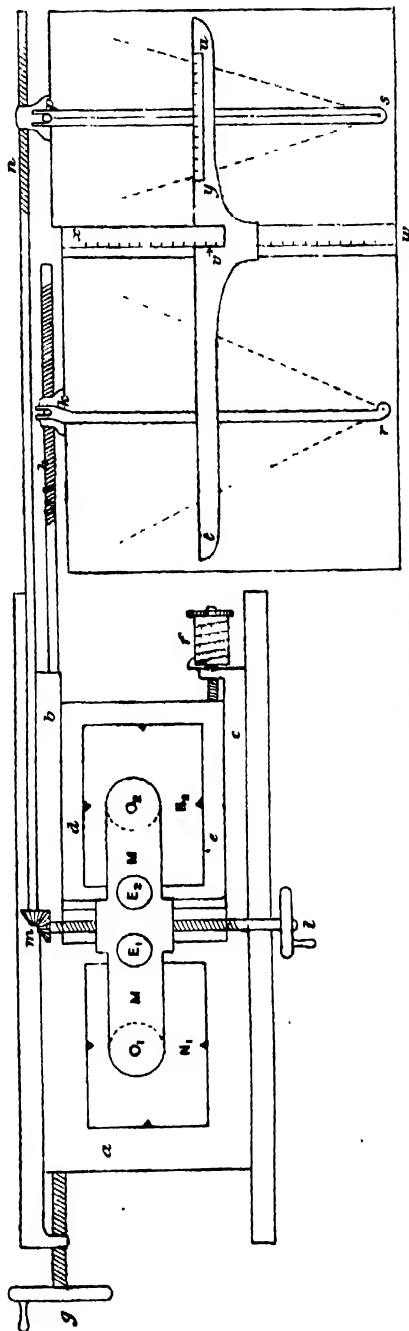


FIG. 10.—THE STEREO-PLOTTER.

In practice, so as not to obstruct the plotting-board, the arms *rk* and *sp* are made twice the focal length, viz. 12 inches, and by means of right and left handed screw threads a double motion is imparted to the travelling collars *k* and *p*. The drum *f* for convenience is graduated in yards for a base of 100 feet and focal length of 6 inches, but can be used with varying focal length and base. The scale *wx* is any required scale, usually 2 inches to 1 mile; this allows objects up to 6 miles to be plotted. Usually a 200-feet or 300-feet base is obtainable, in which case a scale of 4 inches or 6 inches to 1 mile must be substituted at *wx* to give a result plotted at 2 inches to 1 mile. For any other variation in base length a scale varying in proportion must be inserted at *wx*.

The most convenient arrangement would be an elastic scale, but as this has not been found practicable so far, a number of scales varying by small amounts have been prepared photographically, and are inserted at *wx* as required.

The great advantage of this stereoscopic method over the Canadian method of intersections is that the surveyor knows that, having taken his pair of views, every point he can see in the view before him will appear in the plotted result. Other advantages are the ease of contouring due to the exaggerated relief effect, and the elimination of time and labour occupied in identifying similar points in two views.

The chief points to be considered are—

1. The most economical procedure in field work and instruments to be employed.
2. The most rapid method of plotting the results.

An outline only of the methods and instruments can be given here, with a few practical suggestions and figures based on the experience gained in the Cumberland survey (see map opposite).

1. *Field Work.*

In the first place, an extensive survey, whether plane-table or photographic, must invariably be based upon an accurate triangulation or network of triangles. The usual method of executing the triangulation is by means of a theodolite. A series of points are thus accurately fixed, and upon them is hung the plane-table or photographic work.

The tendency in photographic surveying is to use a photo-theodolite, which is a camera and theodolite combined. These instruments are necessarily heavy and costly. The construction is unsound as far as the theodolite is concerned, and, considered as a camera, the instrument is cumbersome and excessively heavy. In practice the camera station is seldom the triangulation station—the former being chosen with a view to economical expenditure in plates, and hence in time; the latter being selected with a view to well-conditioned triangles and inter-visibility.

Local conditions will determine the best procedure to be followed in any particular case, but, generally speaking, a surveying camera and separate theodolite party are considered the most economical arrangement. A surveying camera with a light graduated horizontal plate, sufficiently accurate for resection purposes, would often be most useful.

The camera party would usually consist of one surveyor and one assistant (photographer). Each would carry a load of from 15 to 20 lbs. The triangulation party proper, with a 5-inch theodolite, might be a day or so in advance, or the triangulation might have been carried out some time previously. The best form of signal is a light inclined staff, with 2 yards of black or white bunting attached to its end.

All parties traversing the ground should make notes on the topography, such

as directions of current in streams, bridges, names of farms and villages, etc. One of the great advantages of plane-tableing is that every portion of the ground is traversed, and no detail missed.

The measurement of the stereoscopic bases is always desirable, but not always essential. If the camera station is fixed, and also some other point in the view, base measurement may in rapid work be dispensed with. An experimental survey of approximately 50 square miles was carried out by the writer of this paper in the lake district of Cumberland in August, 1907 (see accompanying map). In this case there was an existing triangulation, which had been executed for instructional purposes a few days previously by a party of R.E. officers from the School of Military Engineering, Chatham. The average length of sides was approximately 2 miles. This being a comparatively close network of triangles, no bases were measured, as it was always possible to include a triangulation station in each view pair, and to resect the camera station. Development of the day's work occupied less than an hour each evening. A dark room or tent is not required. Stand or tank development is the simplest method.

The camera equipment was of an improvised nature, being a Canadian Survey camera supplied by Messrs. Sanger Shepherd, and adapted for use in the stereoscopic method by mounting a small sighting telescope on its upper surface. Slow-motion gear was added to its base plate.

Owing to its improvised nature very considerable errors in alignment were introduced, and no corrections were applied. In spite of this, however, the result approximates fairly closely to the Ordnance Survey sheet of the same area. Considerable time was occupied in experimenting with and testing the gear, which had only just been completed. The chief sources of error, so far as the field work is concerned, are—

- (1) error in alignment;
- (2) error in base measurement;
- (3) lack of definition in the negative.

There are other minor sources of error, which may be neglected in the class of work aimed at, where the degree of accuracy required is not greater than 0.5 per cent.

Under given conditions the degree of accuracy attainable can be precisely determined, and, conversely, the conditions for a given degree of accuracy can be arrived at (*vide* 'An Elementary Treatise on Phototopographic Methods and Instruments,' by J. A. Flomer: Chapman & Hall, 1906). Errors in alignment and base measurement are merely matters of instrumental refinement.

Definition of the negative may be considered to depend on the focal length of the camera lens, and the fineness of the grain of the plate. The most economical combination is found to be a 6-inch lens, covering a half-plate, $4\frac{1}{2}$ inches by $6\frac{1}{2}$ inches. It has been found by experiment that a 6-inch rapid rectilinear lens, when stopped down to $f/45$, gives a definition equal to approximately one and a half times the defining power of the normal human eye, viz. approximately $40''$ of arc. This introduces a parallax error in the negative of 0.0016 inch. This error could be reduced by using a lens of longer focus, but the decrease in angle of view would necessitate a greater expenditure in plates and time, or larger plates and camera, entailing considerable increase in weight, bulk, and cost of equipment.

The probable error in a single stereoscopic observation in the stereo-plotter is found to be 0.0012 inch. This includes the error in setting of plates, scales, etc. A monocular observation, on the other hand, would give a probable error greater than 0.0012.

This error 0.0012 inch in parallax reading could be reduced by greater refinements in the instrument or by using a finer-grained plate and a more perfect lens.

The following table of errors has been prepared so that the conditions for any required degree of accuracy can be ascertained. The probable errors in alignment and base measurement assumed, viz. 20 seconds of arc and $\frac{1}{400}$ respectively, are large and not likely to occur in any work of a careful nature, but might appear in rapid reconnaissance work.

DATA FOR TABLE OF ERRORS.

Camera lens, 6-inch focus.

(1) Probable error in alignment = 20 sec. arc.

(2) Probable error in reading of parallax and setting of plates and scale in stereo-plotter = 0.0012 inch.

(3) Probable error in rapid base measurement = $\frac{1}{400}$.

a = error in range due to (1)

$$= \frac{(\text{range})^2 \times 20 \sin 1 \text{ inch}}{\text{base}}$$

p = error in range due to (2)

$$= \frac{0.0012 (\text{range})^2}{\text{base} \times 6 \pm 0.0012 (\text{range})}$$

b = error in range due to (3)

$$= \frac{(\text{range})}{400}$$

$$\text{Mean error} = \sqrt{a^2 + p^2 + b^2}$$

TABLE OF ERRORS.

Range.	Base 100.			Mean error.	Base 200.			Mean error.	Error in height.	
	a	p	b		a	p	b		Base 100.	Base 200
500	0.2	0.5	1.2	1.2	0.1	0.2	1.2	1.5	0.2	0.3
1000	1.0	2.0	2.5	3.2	0.5	1.0	2.5	2.7	0.6	0.5
1500	2.2	4.5	3.7	6.2	1.1	2.2	3.7	4.2	1.2	0.8
2000	4.0	8.0	5.0	10.2	2.0	4.1	5.0	6.8	2.0	1.4
2500	6.2	12.6	6.2	15.3	3.1	6.3	6.2	9.8	3.1	1.9
3000	9.0	18.1	7.5	21.5	4.5	9.0	7.5	12.0	4.3	2.4
3500	12.7	25.7	8.7	29.9	6.4	12.9	8.7	16.8	6.0	3.4
4000	16.0	32.2	10.0	37.3	8.0	16.2	10.0	20.6	7.5	4.1
4500	20.2	40.8	11.2	46.0	10.1	20.4	11.2	25.3	9.4	5.1
5000	25.0	50.5	12.5	57.7	12.5	25.1	12.5	30.8	11.5	6.2
6000	36.0	72.5	15.0	82.3	18.0	36.2	15.0	43.1	16.5	8.6
7000	49.0	99.0	17.5	112.2	24.5	49.5	17.5	57.0	22.4	11.4
8000	64.0	130.0	20.0	146.2	32.0	65.0	20.0	75.1	29.2	15.0
10000	100.0	204.0	25.0	228.0	50.0	102.0	25.0	116.3	45.6	23.3

Focal length of camera lens = 6 inches.

(a) p.e. in alignment = 20 seconds of arc.

(p) p.e. in reading of parallax = 0.0012 inch.

(b) p.e. in base measurement = $\frac{1}{400}$.

100 yds. on scale 1 inch to 1 mile = 0.057 inch.

Note.—Errors in height are calculated for points at a mean elevation or depression of 10°.

From the above table and formulae, the degree of accuracy for any set of conditions can be determined, or any required degree of accuracy ensured by variation in the length of stereoscopic base and focal length of camera lens.

2. *The Plotting.*

The nature of the country, the scale of the map, the vertical interval of the contours, will determine the number of points to be fixed per square mile. Under average conditions, it may be taken to vary from 50 to 200. For economical work, a plotting machine should be able to keep pace with a camera party; that is to say, it should be capable of fixing in plan and altitude from 500 to 2000 points per diem.

By the Canadian method of intersections, twenty-five points plotted by at least three rays is considered a good day's work.*

Mr. Fourcade's instrument, which works on similar lines to Dr. Pulfrich's stereo-comparator, gives twenty-five points per hour in the hands of an observer who has had no practice.†

The stereo-plotter was designed with a view to increasing the speed of plotting. It has been found that with this instrument from 100 to 150 points per hour can be fixed. The present instrument is an experimental one only, and admits of several improvements which would increase the speed of plotting and its accuracy.

The procedure adopted in plotting was as follows. The triangulation stations lowered, and the resected camera stations numbered, were carefully marked on a large sheet of tracing cloth. Each piece of plotting when completed was then placed beneath the tracing and oriented by means of two fixed points, or one point and an azimuth. The detail was then traced on the tracing cloth.

In this way the map was built up, and very little adjustment was found necessary where the different portions met.

The rate of plotting of the Cumberland survey was approximately 8 square miles per diem, the rate of field work was 10 square miles per diem. From 40 to 70 points per square mile were plotted. In considering these figures it must be remembered that this was a first attempt, and executed with more or less improvised instruments. The advance made, however, is encouraging, and I am now considering the design of an improved plotting machine, or "stereo-planigraph," which will be entirely automatic, and in which contours can be traced direct on the plotting sheet without any reference to scales or settings, and without moving the eyes from the eye-pieces of the stereoscope. Preliminary drawings have been shown to Mr. Conrady, whose expert advice throughout has been of the greatest assistance. He is of opinion that the construction of the instrument offers no insurmountable difficulties. The increase in speed and accuracy of plotting should be very considerable.‡

After the paper, Sir DAVID GILL: I note with very great interest that with observations by stereoscopic methods you get twice the amount of precision that you do from measurements depending upon angles at right angles to the line of sight. That was Prof. Forbes's experience. He said that with his little balloon with the rope hanging down (which corresponds with the bottle-shaped figure in this apparatus), he found he could get the appreciation of parallactic displacement twice as accurately by the stereoscopic method as he could by the

* *Vide* 'An Elementary Treatise on Phototopographic Methods.' By J. A. Flemer.

† *Journal of the Institute of Land Surveyors of the Transvaal*, vol. 1, No. 6.

‡ Since writing the above, funds have been allotted by the Royal Engineer Committee for the construction of a new light camera equipment and an improved stereo-plotter. Experiments will probably be carried out with these instruments in the course of the summer.

method of measurement at right angles to the line of sight. With regard to the details of this instrument as described in this paper which was kindly sent us in advance, I venture to suggest that it might be a very good thing if an appendix to the paper could be given written from a technical point of view, describing more perfectly and technically and without fear of an algebraic expression exactly what it is the author has done, and desires us above all to understand. The only objection I find to this method of plotting co-ordinates is that you do not get the full advantage by that method of the magnifying power which you apply in reading the negatives or positives from it. The mechanical translation from the instrument to paper necessarily involves some loss of accuracy, and of course, if one wanted really, with a 6-inch focus, to get the utmost that could be got from the instrument, you would use a much larger measuring apparatus, and magnify the original photographs so as to diminish the mechanical errors of the reproduction. I might remark that the estimated error of $\frac{1}{200}$ in the measuring of the base by an invar wire is a most extravagantly large one, because you can, without the very least difficulty, measure to $\frac{1}{100000}$, and with all possible precaution to $\frac{1}{1000000}$.

Major HILLS: I should like to say a few words, perhaps in the first instance somewhat in the nature of a personal recantation, because I have been rather sceptical about photographic methods of surveying, and some time ago, when I first heard of the stereoscopic method, I was not inclined to believe in it. I must, however, say that after seeing how the work is done and how simple the operations are, I am completely converted to the photographic method as applied in this particular development of it. The principal difficulty of photographic surveying in the past has been the identification of points as seen from different stations. That difficulty is not only got over here, but I may say rather more than got over, because I think it is actually easier to identify points in these photographs than on the ground.

Another salient advantage of this method is the rapidity of the plotting, and consequently the old objection to photographic surveying, viz. its extreme slowness compared with plane-tabling, disappears. This can be further accelerated if two men are employed, one to set the microscopes, and one to draw. I think this stereoscopic method, combined with a plotting machine, as shown us this afternoon, has a very large future before it.

Mr. CONRADY said that in his opinion the accuracy of the map produced on the instrument did not depend upon the mechanical transmission of the direction and height to any great extent. The parallax, on which the distance of the various points depended, was a very small quantity, and it was the accuracy attained in the measurement of this by a coarse screw that put a limit to the precision attainable by the instrument. If speed in working were sacrificed a fine micrometer screw might be substituted for the measurement of the parallax, and the accuracy of the resulting map would be increased without sacrificing the mechanical transmission of two of the co-ordinates.

Major CLOSE: Before thanking Mr. Thompson for his lecture, I should like to say that Mr. Reeves* will give us a demonstration of his new distance finder, and I think it would be better if we had that paper first; then we could get round the instruments and examine them afterwards. As regards the paper we have just listened to, I think myself that the method is certainly bound to come in for future local exploration, but I do not think it is likely to be adopted for exact and extended surveys for a very long time. I do not think you have got the accuracy

* See *Geographical Journal* for April.

necessary, and it has the fundamental defect that you do not walk over the ground; and also there is this difficulty, that in wooded country and in flat country you really cannot use it at all. But I think it should undoubtedly be adopted by people who are engaged in exploring mountainous regions which are difficult to get at, or in the ordinary explorer's work where a man may very likely camp for a week or two in a place, where he can take the photographs; after he comes home these can be developed and a regular map produced—something very much better than the explorers bring home now. There is one other point I should mention. I think I may say, on behalf of the Research Department, that we do not mind how technical a subject is. This time we ought certainly to have an appendix to the paper, an appendix which will give the more technical side, which has been omitted in the paper which was circulated. On your behalf I beg to thank Mr. Thompson for his exceptionally interesting paper.

REVIEWS.

EUROPE.

FRANCE.

'La France.' By Vidal de la Blache, Membre de l'Institut. With 302 engravings and maps in the text, and a separate coloured map. Paris: Hachette. 1908 [1907]. Price 25 fr.

THIS admirable and indeed model geographical work, model in point of style as well as of geographical interest, was reviewed on its original publication on p. 112 of vol. 23 of the *Journal*. It has now been converted into a handsome quarto volume, with wide margins and numerous pictorial illustrations, which add to its geographical value; for these views are all carefully selected to illustrate distinctive geographical features, and all have notes appended to set forth their geographical significance. The only complaint that can be made is that these notes are in a type rather too small, and, on the glossy paper, rather too faint to be easily read, especially where the lines run across the whole width of the page, and are thus not very easy to follow.

G. G. C.

ASIA.

BURMA.

'The Province of Burma.' By Alleyne Ireland. Boston and New York: Houghton & Mifflin. Two vols. Pp. xxi., 1023. 2 Maps. Price \$10.

These two massive volumes are the first instalment of the Report on Colonial Administration in the Far East, for the preparation of which Mr. Ireland received the appointment of Colonial Commissioner of Chicago University in 1901. In a general preface he acknowledges the very full assistance, both official and unofficial, which he has received in the prosecution of his work, and these two volumes alone are sufficient evidence of the careful use he has made of it. He premises that no attempt has been made to render the volumes attractive to the general reader, but no reader could fail to appreciate the admirable arrangement of the volumes considered as works of reference; the only possible criticism in this connection appears to be that, in view of the full analysis of each chapter given in the contents table, the index might, perhaps, to a greater extent than it does, have given each detail in its own alphabetical place, instead of grouping details under general headings, or

omitting them. To take one example, the word "roads" does not appear, yet these are fully treated. Mr. Bartholomew has provided a map of Burma, and a political map of Further India and the archipelago.

The author opens with a general description of Burma. Serving, as it does, merely as an introduction to his special subject, it is of no great length, but, like the rest of the work, it is characterized by very careful classification, and so leaves a clear impression. The history of the British acquisition of Burma is followed by an ethnographical chapter. The government in its present form is then dealt with, preceded by a short historical summary. The next chapter (the fifth) deals with the general administration of the country; the next with the civil service, and here the opportunity is taken of describing at considerable length the Indian Civil Service, with a historical retrospect, and full details as to the present method of examination and appointment. A chapter on each of the following subjects: judicial administration, police, prison administration, public instruction—the last a long chapter of particular interest—brings the first volume to an end, with the exception of a number of appendices, classified in their relationship to matter in the preceding chapters, and in great part statistical. The second volume is mainly concerned with finance and special and local administration. Three chapters are devoted to the first of these subjects, the importance of the land-revenue system demanding one. There follow the administration of the forests, and public works, including communications (railways and canals), irrigation works, etc. Then in successive chapters the administration of municipalities, villages, medical and sanitary affairs, harbours, the Shan states, and the Chin hills are dealt with, and the final chapter is devoted to trade and shipping. As in the first volume, a number of appendices follow, principally statistical, but including details of the opium regulations, and of the land-revenue settlement in Lower Burma. There is also a glossary of Indian and Burmese words used in the course of the work, and a "contribution to a bibliography of Burma," but it should be noted that, in addition to the latter, the author has adopted the admirable plan of quoting the leading works of reference and other sources for each subject at the head of each chapter.

The value of these volumes to students of anthropogeography is evident, and in undertaking his stupendous task, Mr. Ireland has rendered invaluable service to all interested in tropical colonization.

AFRICA.

EGYPT.

'Modern Egypt.' By the Earl of Cromer. 2 vols. London: Macmillan & Co. 1908.
Price 24s. net.

To the student of modern Egypt, who is versed in the very extensive literature on the subject, this authoritative—and, one might almost add, semi-official—work by Lord Cromer will be found most illuminating. It is not only a *précis* of British policy by its leading exponent, but also an historical retrospect of the rehabilitation of Egypt: from its bankruptcy through Ismail Pasha to the recognition—and, to some extent, the regularization—of the British Occupation by the Anglo-French Agreement of 1904. In a word, it is the commentaries of the Emancipator of Egypt.

Lord Cromer, as an historian, possesses the rare qualification of being able to get "outside of himself" as a statesman and man of action: he criticizes freely and impartially his own participation and responsibility in the events recorded. The spectacle of this great Proconsul rendering an account of his stewardship is very piquant. He examines, with the skill of an expert behind the scenes, each critical

period in the regeneration of Egypt and of her adventures in the Sudan; he quotes elaborately, not only from official, but also from private, despatches to illustrate his arguments; and he concludes his work with a general survey of the country, the details of which may be studied in his annual reports to H.M. Government. He accepts responsibility and awards it with a fearlessness that is always logical and often generous to others. The careful calculation and cold sanity of his policy and views, which have borne the test of time and experience, are lucidly and modestly expounded; and the dramatic episodes are described with the freshness and charm of a gifted man of letters. He deals with general principles, and his treatment is broad and philosophical. Our only quarrel with him is that he should have adopted the French transliteration of place-names—and, worse still, in some instances only.

The first part of this work ends with the fall of Ismail, when a new order of things was introduced into a Pasha-ridden land; the second part is concerned with Tewfik and the Arabi revolt; and the third part deals with events in the Sudan, from the massacre of the Hicks' expedition to the death of Gordon and the evacuation of the country, including chapters on the reconquest of Khartum and the defence of Egypt. The chapters of the concluding parts deal with the dwellers in Egypt, the machinery of Government in this land of paradox, the reforms introduced in the several departments, and with the future of Egypt.

Under these heads, some of Lord Cromer's *dicta* may be quoted. Speaking of the Anglo-French Note of January, 1882, he says: "From the moment the joint Note was issued, foreign intervention became an almost unavoidable necessity." Summing up the issue of Tel-el-Kebir, he says: "The true nature of the Arabi revolt was misunderstood. It was more than a mere military mutiny. It partook in some degree of the nature of a *bonâ fide* national movement. . . . It was, in a great degree, a movement of the Egyptians against Turkish rule. . . . Armed British intervention was, under the special circumstances of the case, the only possible solution of the difficulties which existed in 1882. Probably also it was the best solution." In regard to the Sudan, Lord Cromer states: "Mr. Gladstone's Government made two great mistakes in dealing with Soudan affairs in their early stages. . . . The Government did nothing to stop the departure of the Hicks expedition. . . . No Englishman should have been sent to Khartoum. . . . It was a mistake to choose General Gordon. . . . It is, in my opinion, to be regretted that General Gordon was not allowed to employ Zobeir Pasha. . . . A great and inexcusable mistake was made in delaying for so long the despatch of the Gordon relief expedition. . . . The Government acted wisely, after the fall of Khartoum, in eventually adopting a defensive policy, and in ordering a retreat to Wadi Halfa. Lastly, it may be said that the British Government were extraordinarily unlucky."

Speaking of the future of Egypt, Lord Cromer says: "I make no pretension to the gift of political prophecy. I can only state my deliberate opinion, formed after many years of Egyptian experience, and in the face of a decided predisposition to favour the policy of evacuation, that at present, and for a long time to come, the results of executing such a policy would be disastrous. . . . It may be that at some future period the Egyptians may be rendered capable of governing themselves, . . . but that period is far distant. One or more generations must, in my opinion, pass away before the question can be even usefully discussed." Finally, Lord Cromer states: "Egypt must eventually either become autonomous, or it must be incorporated in the British Empire."

A. S. W.

SOUTH AFRICA.

'History and Ethnography of Africa south of the Zambesi.' By G. McCall Theal, LL.D. In three volumes, with Maps and Plates. Vol. 1, "The Portuguese in South Africa from 1505 to 1700." Pp. xxii. + 501. Swan Sonnenschein, 1907. Price 7s. 6d.

Since the late seventies, when he first began to publish, Dr. Theal has issued so many more or less comprehensive works on South African matters, under the same or diverse titles, that the bibliographical record has become somewhat confused. It is therefore desirable to explain that the present is the first volume of the third edition of the history of South Africa from the advent of the Portuguese in 1505 to the British occupation of Cape Colony in 1795. But here again the general title is modified by the added word "Ethnography," a change, however, which is fully justified by the large amount of fresh matter now introduced concerning the Bushmen, the Hottentots, and the Bantus, that is, the three main sections of the native populations south of the Zambesi.

This added matter, which occupies about one-third of the whole volume, is of special value, being for the most part the result either of original research, or of information obtained at first hand by the author during his long association with the aborigines. Nor are the details confined to the present inhabitants, and ample references are made to the shell-mounds of Mossel bay and the East London district, as well as to the rude unpolished implements which correspond to the palæoliths and eoliths of the northern hemisphere, and "have been found in situations where they must have lain undisturbed for an incalculable length of time." Early man is thus seen to have ranged all over the Austral region, where he is probably still represented by the nearly extinct Vaalpens of the Limpopo valley, who are quite distinct from, and far more debased than, the Bushmen, though often confounded with them. Unfortunately, they have been overlooked by Dr. Theal, unless they be the people about whom he tells us that the Transvaal Bantus had a tradition that on their first arrival on the banks of the Limpopo they met some savages who had no knowledge of fire, and whose only weapons were sticks and stones.

On the difficult question of Hottentot-Bushman relations, the theory is advanced that both were originally of one stock, which had its cradle in Central Africa, whence they migrated at long intervals to their present seats south of the Zambesi. The Bushmen came first, and were followed after a great lapse of time by the Hottentots. That interval was so great that the Hottentots had advanced from the hunter to the pastoral stage, and, perhaps by an infusion of Hamitic blood, had increased in stature, while their character and habits had undergone a marked change, losing "much of the energy and alertness which distinguished the Bushmen, because their mode of existence no longer required the exercise of these qualities."

The Bantus also are brought from the north, but were preceded in the present Rhodesia by a far more cultured people of uncertain provenance, to whom are attributed the extensive gold-mines, the associated monuments, and vast irrigation works of that region. They may have been "traders from the great commercial city of Tyre," and it is suggested that "the fleets that went down the Red Sea to Ophir in the time of Solomon are not inapplicable to voyages to the Zambesi or to Sofala. What is certain is that at some time in the past, of which there is neither written record nor tradition now, mining operations were carried on over an immense tract of country south of the Zambesi." The present Bantu populations, referred to as "recent immigrants," are expressly excluded, while the late date of a few centuries assigned by Dr. Randall MacIver to the works is obviously regarded by Dr. Theal as paradoxical.

The historical section of the volume, having already been noticed, need not

detain us, and it only remains to say that the absence of an index is all the more to be regretted, since the author tells us that each volume may be regarded as a complete work in itself.

A. H. K.

TUNISIA.

'*La Tunisie et l'œuvre du protectorat français.*' By Gaston Loth. Paris: Librairie Ch. Delagrave. 1907. *Price 4 fr.*

M. Gaston Loth, Director of the Collège Alaoui at Tunis, is already known as the author of several well-informed books on Tunisia. The volume now before us is specially devoted to a survey of the progress made in the regency under French direction—that is, since 1881. The beylical government, the judicial organization, the financial régime, education, defence, communications, the land laws, agriculture, and commerce are all described in a lucid and concise manner, so that the actual condition of the country is plainly exhibited. France has good reason to be proud of the results of her twenty-five years of labour. Her task in Tunisia has been of much the same character, though more free from international fetters, as that England had to face in Egypt. In both instances the most striking result has been the increase of the economic resources of the countries occupied. While, however, the material prosperity of Egypt continues to depend upon agriculture, Tunisia a few years hence will find its chief source of wealth in its enormous deposits of phosphates. It already exports more phosphates than any other country in the world. The ultimate effect of the development of this industry can only be conjectured; though it will scarcely make the Tunisian deserts blossom like the rose, it will bring back to the land something of the prosperity it enjoyed in Roman times.

Besides the subjects mentioned, M. Loth has a short opening chapter on the physical aspect of the country, in a few striking sentences giving the characteristics of the four zones into which Tunisia is divided; and in his four last chapters he gives a topographical survey of each of these zones, with special descriptions of the chief towns, and brief notes on the principal antiquities. When it is added that there are also two chapters in which the history of Tunisia is summarized, the comprehensive nature of the work will be realized. Ethnography is almost the only subject left untouched. M. Loth, nevertheless, calls attention to the fact that, despite their subjection to Carthage, Rome, the Vandals and Byzantines, Arabs, Spaniards, and Turks, the Berbers have retained their distinctive character without sensible modification. He accounts for this fact by a consideration of the nature of their country. "Sur un sol fractionné en une multitude de petits cantons géographiques les Berbères devaient forcément vivre en tribus isolées les unes des autres; les divisions intestines seront la règle, l'entente sera l'exception. Ainsi s'explique la série des dominations successives, la violence des mouvements de réaction, le caractère éphémère des victoires nationales." This argument, if not fully convincing, is another demonstration of the importance of a knowledge of geographical conditions to a comprehension of history, as well as to the study of ethnography. The book has over seventy illustrations, but no map.

F. R. C.

POLAR REGIONS.

ARCTIC EXPLORATION.

'*Round about the North Pole.*' By W. J. Gordon. London: Murray. 1907. Pp. xii., 294. *Maps and Illustrations. Price 15s. net.*

This summary of Arctic exploration is laid out upon somewhat novel lines. It has been the author's object to deal with "the gradual progress of exploration towards the north along the different areas of advance within the Arctic Circle."

Consequently, we find successively treated Spitsbergen, Novaya Zemlya, Franz Josef Land, Cape Chelyuakin, the Lena delta, Bering strait, northern North America, the Parry islands, Boothia, Baffin bay, Smith sound, and Greenland. This feature undoubtedly gives the book individuality and value, for though it has been easy hitherto to follow the course of any one explorer northward, it has not been so easy to group the work of many explorers in any one area. In justice to the author, this has to be borne constantly in mind in reading the book. Otherwise, if the reader had expected a narrative historically complete even within the small compass of this volume, he might receive a certain shock on meeting the name "Fridtjof Nansen" (to take a single case) as the leader of an expedition without any foregoing introduction whatever. In effect, regarded from the point of view of the student of Arctic history, Mr. Gordon's is neither the first nor the second book he should take up; but with its aid he can classify geographically his knowledge already acquired. The unlearned reader will hardly find the book satisfactory. For the rest, one observes occasionally a certain looseness of expression, as when one reads how the *Windward* was able to escape from Franz Josef Land, and "to return in 1896 and take away Nansen, who . . . ended his long land journey here."

The interesting series of illustrations are from woodcuts, etc., by Mr. Edward Whymper, drawn from a variety of sources. One or two from early originals are exceedingly interesting; some studies of polar scenery are beautiful; all are well produced. The maps are black-and-white sketch-maps.

THE ARCTIC SEAS.

'Osnovy Gidrologii Evropeiskago Ledovitago Okeana.' N. M. Knipovich. O 10-1u Tablitsami Kart i Profilei. St. Petersburg: Tipographia M. Stasiulevicha. 1906. Pp. 1510. (*Zapiski of the Russ. Geogr. Soc.*, vol. 42.)

In this bulky volume the present state of our knowledge of the Arctic seas north of Europe, from Spitsbergen and Bear island eastwards to Novaya Zemlya, including the White sea, is set forth in considerable detail. The most voluminous and important records utilized are those of the author's own expedition along the Murman coast in the years 1898-1901, but he has also collected other material from later and earlier investigations. The observations are very unequally distributed, and for large areas are entirely wanting, or have been obtained for a small part of the year only, and this work will serve to show where exploration is most needed. The different oceanographical subjects, such as depths, temperature of the surface and deep waters, salinity, transparency, currents, distribution of ice, etc., are treated with great fulness, and the literature relating to the hydrology of the area is noted with comments. In a supplement to this chapter the author criticizes certain arguments and conclusions of Prof. Pettersson, especially those contained in his article on ice-melting in the number of this *Journal* for September, 1904, and in his 'Ueber die Wahrscheinlichkeit von periodischen und unperiodischen Schwankungen in dem Atlantischen Strome,' etc., which appeared as vol. 3 of the reports of the International Council for the exploration of the sea.

For the use of readers who are not acquainted with Russian, a long summary is added in German, wherein the contents of each chapter are noted, and references given to the tables, etc. Mr. Knipovich has also given sketches of his own work in the *Annalen der Hydrographie* and the *Revue internationale de pêche et pisciculture*.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

GEODESY.

'Missions Scientifiques pour la Mesure d'un arc de Méridien au Spitzbergen.' 1899-1901. Mission russe. Tome I. Géodésie, Sections III. Aa, Ab, B, C; IV. B, V. Mission suédoise. Tome I. Géodésie, Sections II. B, Y.

These reports of an interesting piece of geodesy and exploration, the joint measurement of an arc of the meridian in Spitzbergen by Russian and Swedish missions, contain the detailed discussions of several sections of the work. It will presumably be some time before the whole of the reduction can be brought to a conclusion and published; but in the mean time one or two salient points emerge clearly at this stage, to which reference may be usefully made.

The chief among these relates to the question of base measurement, dealt with in the Russian report, sect. III. Ab. The account of the Swedish base has not yet appeared. This description brings home in the clearest manner the enormous advance that has been made by the substitution of the nickel-steel wire for the old-fashioned compensation bars or rods. In this case the conditions were by no means favourable. The base was irregular in contour, and traversed rough and marshy ground, while the weather was far from ideal, and yet the whole of the work, including the laying out of a standard and the comparison of the wires, was completed in less than three weeks, while a high degree of precision was attained.

The cycle of operations was as follows: An auxiliary base, 175 metres long, was measured with Struve's apparatus thrice before the main base measurement and thrice afterwards. The two wires used for the main base were standardized on this subsidiary base immediately after it had been measured. Each wire was thus compared with the standard four times—twice before and twice after use. The main base, 6·2 kilometres long, was measured twice in each direction by each of two wires, eight measures in all. This part of the work extended over ten days. The limit of error in the final value is 17 millimetres—say, 1 part in 360,000.

It is doubtless true that other bases—those, for example, executed by Colonel Sir William Morris in the Transvaal—have reached a higher degree of precision, while the speed of work has not appreciably differed from that attained in Spitzbergen. The conditions of the two cases are, however, very different, and the congratulations of all surveyors are certainly due to M. Backlund for the extremely efficient way in which he carried out the task entrusted to him. A perusal of this account suggests the question whether we in this country could not learn a useful lesson from a study of Russian methods, and could not, with advantage, specialize our survey work in at least one direction. The operation of base measurement is one of which the necessity arises only at the beginning of the survey of an area, and in which, therefore, the ordinary survey department has little or no experience. Might it not be to the advantage of the survey of the British Empire if there were available in this country one or two men of highly trained technical skill, equipped with the best possible apparatus, prepared to go to any part of the world and measure an initial base for the local survey? The money spent in journeys would be more than saved—firstly, by the unquestionable gain in accuracy and the consequent avoidance of the costly necessity for repeating bad work; and secondly, by the gain in time, due to the fact that the local staff would not be called upon to learn the use of an unfamiliar, though doubtless simple, set of instruments. This is, however, hardly the place where such an idea can be profitably developed, and it may be here left to be reverted to elsewhere.

Before quitting it, we may note that M. Backlund left the observatory at Pulkowa on June 11, and returned to it on July 24. It was therefore possible to

standardize the wires, not only by the check base on the spot, but also by the permanent standards of the observatory, within three weeks of their use for the actual measurement. It need hardly be pointed out that this was eminently favourable to the attainment of the highest practicable exactitude.

The observations and reductions of the horizontal and vertical angles of the triangulation are as yet too incompletely published to be available for discussion. Owing to the unfavourable terrain, the bad weather conditions, the short summer, and the necessity for keeping the stations near navigable waters, it was seldom found possible to place the observing instrument under or even near the signal. Almost all the points had therefore to be treated as "satellite" stations, and the reduction to centres assumed an importance rare in first-class work. It will be interesting to see what effect this had on the precision of the horizontal angles.

The discussion of the deviation of the plumb-line shows, as might naturally have been expected, a considerable variation in the local attraction at different parts of the islands. The mean deviation over the whole area covered by the triangulation is therefore very high, amounting to 3''·6 in the meridian and 6''·4 in the prime vertical. Some part, but not all, of the irregularity can be accounted for by the distribution of surface rocks. The remaining part is presumably due to deep-seated rock masses, and M. Bonsdorff makes a calculation of the size and shape of a mass of diabase such as would approximately account for the observed deviation.

In conclusion, we may express the hope that the remaining sections of these reports will appear at no very distant date, and thus complete the account of a work constituting a valuable addition to our precise knowledge of the Earth's surface.

E. H. H.

COMMERCIAL HISTORY.

'A History of Commerce'. By Clive Day, PH.D., Assistant Professor of Economic History in Yale University. New York: Longmans. 1907. *Price 7s. 6d. net.*

This work cannot be too strongly recommended. Though designed only as a text-book for use in schools and colleges, it must have cost enormous labour to prepare, but the labour has been well bestowed, and has resulted in giving us the best general history of commerce in the English language, and one that in all probability will not be speedily eclipsed. The judgment with which the volume is written is as conspicuous as the learning, and the judgment is shown not merely in that proportion which the author tells us, he has given special care to attain, exhibiting, however, that care equally where he allows himself to expatiate in details and where he contents himself with broad summaries, but also in his handling of controversial topics, which he does not shirk, but treats with uniform dispassionateness and a direct regard to the facts, an independence and sagacity which inspire confidence. The work is not directly based on geography, but must be of great value to geographers. The numerous incidental references to geographical considerations appear to be generally if not invariably sound, and there are thirty-four maps, some of the most instructive of which have been specially compiled by the author. An excellent feature is the bibliography, partly in the form of authorities for each chapter, and partly in forty-four pages preceding the index—a bibliography whose value is much enhanced by "a brief description or appreciation of the books that are recommended for further study," and by special references to the precise sources of information with regard to many of the questions set on the different chapters. That the book should be faultless is more than any one could expect, but certainly the author's modest "hope that merits will be found to counterbalance the faults" is amply fulfilled. Still it may be of use to point out a few of the defects. Occasionally

there is a certain failure of judgment. On p. 492 we find the statement that during the wars of the time of the French revolution and Napoleon "the carrying trade of the world fell into our hands" (that is, those of the United States), but when we read on the opposite page that even then the merchant tonnage of the United States was only second to that of Great Britain, it becomes evident that the former statement is precisely one of that kind against which a teacher has so often to warn students, an exaggeration due to expressing in a universal proposition what is intended to be understood only as a partial one. A similar instance is the ascribing, on p. 109, to mediæval England a practical monopoly of tin production, which is (rightly) contradicted by the map on the opposite page. It is strange to find an American belittling the achievement of Columbus on the ground that if he had not shown the way to the New World, somebody else about that time would have done so (p. 133). Surely the consideration which he urges on p. 129 on behalf of earlier navigators, that "when we add to the actual peril of distant voyages the imagined dangers which the minds of men ascribed to unknown seas, we must admit that the early explorers met a test of courage to which men nowadays are rarely put" shows a much sounder attitude. Mr. Day either has not noticed or does not accept Mr. Ravenstein's correction of the date of the voyage of Bartholomew Diaz round South Africa (*Geographical Journal*, vol. 18, p. 646). The reference to the Jews as the sole money-lenders in Christian countries in the Middle Ages takes no account of the doings of the Florentines, which brought them into evil odour at that time, and caused even writers of the nineteenth century to speak of the early source of Florentine wealth in a regretful and apologetic strain. The map of the Trans-Siberian railway on p. 449 errs in not showing its completion round the south end of Lake Baikal; that of the waterways of North Central Europe on p. 294 represents the rivers as navigable to their sources, not giving, as the explanation would lead one to expect, the limit of navigation; that of River Transportation in the United States in 1860 ought to show the break in navigation on the Mississippi above St. Paul; that of the Development of the German Zollverein on p. 394, though correct, fails to bring out the point mentioned on the opposite page of the text as to the important step made at the beginning of 1834. On p. 284, Mandaley for Maudaley has escaped correction in proof-reading. In a work printed in America one is prepared for differences from ordinary English spelling, but is it the case that in the United States no distinction is made between "council" and "counsel"? On p. 177 "councils" appears where in our English book at least we should have expected "counsels." The greatest defect in the work is the very inadequate index. An index in which no entry is found of the English or any other East India Company must be a defective one for any *History of Commerce*. But this defect is largely compensated by a very full table of contents.

G. G. C.

SHORT NOTICES.

Europe.—‘The Itinerary of John Leland.’ Parts iv. and v. Edited by Lucy Toulmin Smith. (London: George Bell. 1908. Pp. viii., 192. 12s. net.) This handsome volume continues the new edition of the Itinerary, that of the three first parts having been noticed in the *Journal* for October, 1907. “Part iv.,” the preface shows, “is not Itinerary, but consists of notes for it, chiefly on men and families. . . . Part v. is narrative Itinerary, . . .” which is illustrated by a simple, clear map. The volume also contains an appendix of collectanea, the result not directly of travel, but of research on the part of Leland.

Asia.—‘Wanderings in Arabia.’ By Charles M. Doughty. (London: Duckworth. 1908. Two vols., pp. xx., 309; x., 297. *Map and Portrait*. 16s. net.)

This is an abridged edition of the author's celebrated 'Travels in Arabia Deserta,' arranged, with a preface, by Edward Garnett. The editor has catered for a somewhat wider public than that to which the original appealed, by preserving the narrative of travel and incident, with its striking individuality of diction, at the expense (for the most part) of the more scientific information. There is a glossary of Arabic terms, but no index. Cartographers will note with interest the differences between the carefully constructed map here given, and others, such as that in Stieler's Hand-atlas, as notably in the case of the longitude of Hail.

'La Rivalité Anglo-Russe au xix^e Siècle en Asie.' By Dr. Rouire. (Paris: Armand Colin. 1908. Pp. viii., 298. *Map*. 3 fr. 50.) This book is in the nature of an essay, or series of essays, in modern history; it is, in fact, a co-ordination of articles contributed by the author to the 'Revue des Deux Mondes.' It traces rapidly the events which have led to the present position of the two Powers as regards Persia, Afghanistan, and Tibet, and analyzes that position in the light of the treaty of 1907. It thus forms a very convenient guide to the whole subject, and as such would seem to call for translation.

'The Coming Struggle in Eastern Asia.' By B. S. Putnam Weale. (London: Macmillan. 1907. Pp. xiv., 656. *Map, Diagrams, and Illustr.* 12s. 6d. net.) This volume is stated by the author to complete his series of political treatises dealing with the Far East. As before, his earlier chapters are mainly descriptive in character, dealing with 'Russia beyond Lake Baikal,' and present a clear picture to serve as background to his political arguments. As regards these, it need only be said that his views as to the future do not coincide with those of the government which renewed the alliance with Japan. With the government, army and navy of that empire, its finance, industry, and commerce, he deals at length, a number of diagrams being provided to clarify the latter group of subjects.

'The Ancient History of China.' By Friedrich Hirth. (New York: Columbia University Press. 1908. Pp. xx., 383. *Map*.) This work carries the history of China from the mythological and legendary periods, in the latter of which the earliest date assigned in the exhaustive chronological table is B.C. 2852, to the third century B.C. The professor of Chinese in Columbia University has set forth the story very clearly, with copious references to leading authorities. An inartistic diagram map shows China during the Chón dynasty (1122-249 B.C.). In a preface dealing with the orthography of Chinese names, acknowledgment is made of the system of this society.

Africa.—'A Woman's Pleasure Trip in Somaliland.' By Frances Swayne. (Bristol: Wright. 1907. Pp. xii., 172. *Map and Illustr.* 4s. net.) This short and simple narrative of a journey inland from Berbera to the Golia range, by a relative of Colonel Swayne, the author of the well-known 'Seventeen Trips in Somaliland,' will be read with interest. She has intimate observations to make on the Somalis whom she met, and clear descriptions of the country to give; and the book should especially attract those ladies who have experience of, or inclination for, camping.

America.—'Immigration and its Effect upon the United States.' By Prescott F. Hall, A.B., LL.B. (New York: Henry Holt and Co. 1906. 6s. net.) Mr. Hall examines the problem of emigration and immigration, as affecting the United States, from many points of view. He deals exhaustively with the change of the character of the immigrants in recent years, which has introduced new and complicated problems, economic and social. The geographer, however, is most interested in the origin of the immigrant and his distribution in the United States. Most immigrants now remain in the northern eastern states, while a large number go to the northern central states. The west receives more than either the south, central, or

the south-east, where the population of immigrants is remarkably small. In a few generations most interesting-results will be obtained which should go far to settling the vexed question of the influence of the predominance of racial or environmental factors in determining the character of the individual and of the society.

Australasia.—'In the Land of Pearl and Gold.' By Alexander Macdonald. (London: Blackie. 1907. Pp. xi., 318. *Illustrations.*) This book touches on several important Australasian industries—pearl-fishing, mining of various sorts, sugar-planting, etc. It gives a view, which is well worth possessing, of these industries "from within," and from the standpoint of the pioneer, although, being in narrative form, it is in no sense heavy reading.

General.—'The Romance of Savage Life.' By G. F. Scott Elliot. (London: Seeley. 1908. Pp. 384. *Illustrations.*) This volume of the series, entitled the "Library of Romance," attempts the reconstruction of the life of primitive man. The "romantic" aspect of the subject is well shown, and the book combines a popular tone with much erudition. Special acknowledgment should be made of that too rare feature, a compendious bibliography.

'De Pékin à Paris.' By L. Barzini. (Paris: Hachette. 1908. Pp. xvi., 448. *Map and Illustrations.*) This massive volume is a bright narrative of the journey made by Prince Scipion Borghèse in an "Itala" motor-car from Peking to Paris, told by his companion. This was the journey organized by the *Matin* newspaper. Its result, as showing the capacity of the automobile for progress off the beaten track, is not without interest to geographers at a time when the first car is on its way to take part in polar exploration. To all who follow the development of this method of locomotion, the numerous photographs would alone recommend the book.

'Active Service Pocket-Book.' By Bertrand Stewart. (London: Clowes. 1907. Pp. xxxii., 940. *Maps and Illustr.* 4s. *net.*) Numerous and important additions have been made to this, the third edition of this manual. Of these, the most important in the geographical connection is a list of the principal conventional signs and abbreviations used on Indian and foreign maps. It is noted that many of these signs have had to be enlarged in order to show them clearly; in some cases it is obvious that this principle, if applied, has not been so fully enough, for some of the signs are still not easy to read. But this would be easily remediable, and the list is exhaustive and of first-rate value, adding much to that of this otherwise admirable book, which, in spite of its great number of pages, is little over an inch in thickness.

'Wellcome's Photographic Exposure Record and Diary.' (London: Burroughs Wellcome & Co. 1908. Pp. 272. 1s. *net.*) This valuable pocket-book now reaches its tenth edition. To all photographers who dislike the necessity of judging the correspondence of a tint on sensitized paper with a standard, and therefore do not use the form of exposure-meter which depends on this, the exposure-scale here provided is practically a necessity; but there is, moreover, much valuable information, not only regarding exposure (with calculations for light values for each month at various latitudes) and other technical details, but also on such subjects as permits to photograph in foreign countries. It may also be noted that there are three editions—for the Northern Hemisphere, Southern Hemisphere, and United States.

THE MONTHLY RECORD.

THE SOCIETY.

The Society's Awards.—The Back Bequest has been awarded to Lieut. George Mulock, R.N., for his important services as surveyor on the National Antarctic Expedition, and in the construction of the large chart embodying the discoveries of the expedition.

EUROPE.

The Physical History of the Bohemian Massif.—In an article in the January number of *La Géographie*, Prof. Macháček sums up in a useful way our knowledge of the morphology of Bohemia and neighbouring regions as derived from the geological investigations of many different observers. The Bohemian massif, as is well known, is a block of ancient land which has not, as a whole, been covered by sea since very early geological times. It is one of those areas to which recent German students apply the expressive term "Rumpf-gebirge," which, though corresponding more or less to the peneplain of Davis, is inadequately translated by the latter word. As a French equivalent, Prof. Macháček uses the equally expressive, though perhaps not entirely satisfactory term "carcasse."* The archæan basement of Bohemia, composed of granite, gneiss, and crystalline schists, has been warped out of its original shape, though the process has differed from that which comes into play in true mountain-building. The earlier palæozoic formations have likewise been folded and fractured by the series of movements known as the Hercynian. From the upper carboniferous onwards a continental era set in, and continental conditions were dominant until the great cretaceous transgression. Before this, the surface seems to have been worn down, not by marine, but by subærial denudation. The Cretaceous strata have been subjected to various deformations but not to regular folding, and the movements which caused them seem to date from about the Eocene, when great dislocations, followed by a period of volcanic activity, took place. But these were not the latest tectonic movements to which the massif was subjected. The form of the valleys—deep, narrow, and winding—points to a much more recent movement of elevation, which has restored the erosive power of the streams, and it is with this movement, Post-Miocene in date, that the origin of the Böhmerwald is to be connected. The gorge cut by the Danube to the south is another result of this movement, which must have been closely connected with the wave of deformation which affected the whole of South-Central Europe at this time. In the latter part of the paper, Prof. Macháček treats of the plateau of western Moravia, which belongs essentially to the Bohemian massif, its origin and age being the same. In spite of the variety of the geological formations, these have little effect on the present relief, which is that of a peneplain surmounted by the more resistant portions of the old surface. The general result of the study is to show that the Bohemian massif has been the theatre of recent movements of some importance, which have determined the present forms of its mountains and valleys.

The Transformation of the Lüneburg Heath.—In the *Geographische*

* It is much to be wished that some term, more expressive of the underlying idea, could be substituted in English for the unsatisfactory word "peneplain," though the choice might be a matter of some difficulty. The idea involved might find partial expression in the word "stump," though this is open to objections, and fails to suggest horizontal extension.

Zeitschrift (vol. 40, No. 2) there is an instructive all-round description of the Lüneburger Heide, by K. Olricht. Last century it still presented an almost uninterrupted expanse of heath. Only with the discovery of the Kieselgur beds and the entry of the railway did modern life penetrate the wilderness. Recently, agriculture and cattle-rearing have been making great strides, and the heath is now among the first of Germany's cattle-rearing reserves. The heath-plant is more and more retreating before plough-land and forest, the latter in 1900 claiming 23 per cent. of the whole area. The ruling tree is Scotch pine, which is crushing out beech, oak, and spruce, and engrossing the copses everywhere in formation. It turns out, however, that the pine will not permanently adapt itself to the climate, and must yield to spruce or to broad-leaved trees. Water-meadows and fish-ponds are also spreading with great rapidity. Another factor in the heath's transformation may lie in the discovery of immense potash-beds, and for the first time deep borings for potash are opening to view underground formations of a character essentially different from that hitherto assumed. Here the article enters into a detailed discussion of the geology of the region. Only at Lüneburg does solid rock emerge above the diluvial layers (mostly over 3000 feet thick), and here is seen an almost complete series of the older strata from the Permian to the Miocene. Hardly anywhere does the heath present interminable plains, but, everywhere a beautifully undulating landscape, which, with its characteristic vegetation, contrasts strikingly with the depressed neighbouring regions—Wendland to the east; the Aller valley in the south; the great moors in the west; the deep Elbe valley in the north. Only in the south-east does the small ridge of the Hallberge and the Letzinger heath offer passage to the Fläming. Despite the advance of forest and field, there still remain vast expanses in which, to the horizon, the eye sweeps over almost uninterrupted heath.

Human Geography of the Plains of Lower Languedoc.—Following up the article already noticed in the *Journal* (vol. 30, p. 209), M. M. Sorre has set himself the further task of disentangling the general characteristics of the human geography of Lower Languedoc. The results of this second investigation appear in the *Annales de Géographie* (vol. 16, No. 90). The part of Lower Languedoc here dealt with includes the littoral plains stretching at the foot of the "Coustières" from Nîmes to Narbonne, the pliocene hills of Biterrois, the Hérault valley, and the tertiary depressions to the south of the fold of St. Loup. In contrast to the running waters and market-gardening of Roussillon, and to the flowery fields, terrace-cultures, and forests of Provence, Lower Languedoc from Aude to the Rhone is a sea of vines; its soil of pebbles, clay, and sand offering the vine its choicest nutriment. In the single department of Hérault, the vine now covers 470,000 acres, and in 1904 yielded about 280,000,000 gallons of wine. To the vine as its dominant culture must be referred all the fluctuations of population in the Languedoc plain during the last half-century. Yet under the ancient régime the vine but divided the field with cereals and olives. As late as 1824, Hérault had no more than 240,000 acres under vines. On the invasion of the phylloxera the vine covered no less than 550,000 acres. The revolution thus accomplished in the rural economy, and consequently in the condition of the population, between 1824 and 1860, was followed by the plantation of immense spaces formerly covered with marshes and woods. Such a reconstitution of economy called forth a considerable flow of population towards the "paluns" of Vidourle and the lower Rhone, where the economic situation had been deplorable, and towards the Biterrois, where veritable Spanish colonies were formed. A characteristic of the viticultural plain, due to the prosperity of the vine, is its high density of population, exceeding 280 inhabitants per square mile in the most populous quarters. In contrast, too, with the more inland parts,

more than 85 per cent. of the population of the Languedoc plain is gathered in agglomerate groups. In the canton of Mèze only 5 per cent. of the population lives scattered; in parts of Aude and Hérault only six. Two sketch-maps illustrate the grouping of population, the dependence of this on geological characters being well brought out in the second, which shows how most of the centres choose the Pliocene or Upper Miocene in preference to the recent alluvium.

Leucadia and its Relations with Continental Greece.—A good deal of attention has lately been directed to the island of Leucadia (or Santa Maura), adjacent to the coast of Akarnania, both on the physical and historical side. The theory that it, and not the more southern island, was really the Ithaka of Homer has found several supporters, among them Herr Dörpfeld, who has discussed the question in a brochure of some fifty pages. The physical side has been re-examined in the light of recent surveys by Prof. Partsch (*Petermanns Mitteilungen*, 1907, No. 12), whose former researches on the geography of the island are well known. The question at issue is that of the supposed former connection between the island and neighbouring mainland, the belief in which is based on statements of several of the ancient historians, and Prof. Partsch points out that the recent careful survey by Oberleutnant Walter v. Marées, the results of which have lately been published in Berlin (J. Moser, 1907), are of special value as a basis for its study. The remarkable point in the old story is that the connecting isthmus (supposed to have been cut through by the Corinthians) was placed, not at the north point of the island where it is now almost joined to the mainland by a long spit of shingle (known in part as the "Plaka"), but further south, abreast of the old town of Leukas. Prof. Partsch believes that the historians were incorrect in their statements, and he shows on the one hand that no evidence of a former southern connection has been found during the modern dredging operations in the lagoon; and on the other, that the northern spit of land must already have been in existence in the earliest historical times. As had already been recognized by the geologist Stefani, the lagoon separating the island from the mainland has a structural origin, and is no mere recent formation, even though it has almost certainly been the scene of a movement of depression during historic times. If an isthmus had existed close to Old Leukas, the mole built by the Corinthians further south would have been unnecessary, and Prof. Partsch believes that the operations for opening a passage consisted probably in the clearing away of the accumulations of sand which tend to block the "Stretti Canale" between the Plaka and the mainland coast. At any rate, he thinks the cut must have been through some part of the northern bar. A good case has certainly been made out for this view, though it still seems not impossible that, if the sea-level was once relatively lower than at present, the narrow passage of the "Stretti Canale" may formerly have been entirely blocked.

ASIA.

The Khatanga Expedition of 1905.—A short sketch of the course and results of this expedition, which was frequently mentioned in the *Journal* during the time it was in the field, is given by M. Backlund, the geologist of the party, in the February number of *La Géographie*. Its leader was M. Tolmachof, and its object the exploration of the system of the Khatanga in Northern Siberia, the upper course of which was known only from its chance discovery by Chekanovski soon after 1870, while in search of the upper Olenek. A number of extensive lakes were reported from its upper basin, but, as it now proves, the information regarding them was very erroneous. The expedition set out from Turukhanak on the Yenesei, and went north-east to the upper valley of the Luma, a tributary

of that river, whence two separate parties crossed over into the basin of the Khatanga, one of them tracing the course of the Kotui, its western headstream. This region is characterized by its tabular form (only broken by the deeply out valleys of the Kotui system), which causes the water-parting to take a very irregular course. The plateau is composed of sheets of diabase, which form terraces on the sides of the larger valleys. The rivers form lake-like expansions, often of considerable depth. The two parties having united on the shores of Lake Jessei—the only lake of any size in this region, though much smaller than has been supposed—the next task was the examination of the lacustrine region to the south and the exploration of the Moiero, or eastern headstream of the Khatanga, which last was effected on sledges. This river, unlike the Kotui, has a very sinuous course, and does not trench the plateau like the latter. On the approach of summer, preparations were made (in which much help was received from the Yakuts) for the descent of the united stream of the Khatanga, which took place partly by raft, partly by boat. The voyagers took to the land before quite reaching the mouth of the river, and after tracing the coast east to the mouth of the Anabar, surveyed this river on the return journey. The middle course of the Khatanga has made a deep trench in the Palæozoic limestone, and its precipitous banks are cut into fantastic forms. The rapids which occur in various places are caused by intrusions of diabase. While forming a continuation of the North Siberian plateau, the country between the Khatanga and Anabar lacks the protecting covering of diabase seen on the Kotui, and has been much denuded, descending to the north in a series of terraces. A map which accompanies the paper shows the courses of the rivers, etc., as laid down by the expedition, side by side with their delineation on former maps, and this brings out clearly the extensive changes to be made as a result of the survey.

The Lolos.—The claim of Captain D'Ollone (*Journal*, vol. 30, p. 437) to have been the first to traverse the interior of the Ta Liang Shan—the mountainous habitat of the independent Lolos—has elicited a reminder from M. Bonin, the well-known French explorer, of his journey in the same country in 1898, which was briefly described (with sketch-map), in the *Comptes Rendus* of the Paris Geographical Society for 1899 (*Journal*, vol. 14, p. 206). This traveller, however, traversed only the southern extremity of the country in a diagonal line from Kiao-Kiating to Kien-chang or Ning-yuen, so that a field for further work still remained after his journey. The precise position of research regarding the Lolos and their country has been summed up by M. Henri Cordier in the January number of *La Géographie*. Many of the travellers who have collected information have been little known to the public, at least in this country, much having been done to throw light on the Lolos by French missionaries, like Pères Vial and Guébriant, as well as by travellers like Baber, Bourne, Hosie, Bonin, etc. Besides sketching the history of European travel in or about the Lolo country, M. Cordier summarises what is known of the origin, designations, language, writing, etc., of the people. According to Père Vial, the people say that they originally came from the region between Tibet and Burma, but much obscurity prevails as to their past. The name by which they have become generally known is of course merely a soubriquet employed by the Chinese, who also use the more general term Man-tse (Barbarians). Baber's explanation of the term Lolos as signifying "black bones" is doubted by Bons d'Anty, but M. Cordier quotes Devéria as pointing to a similar expression as in use among the Kirghiz. On the other hand, M. Vial states that Lolo is a Chinese corruption of No—the name of one of their tribes. A special interest attaches to the Lolos of the Ta Liang Shan because they have here maintained themselves in greater purity than in the more outlying districts.

Volcanoes in Northern Japan: Errata.—Mr. Mitford, the author of the article on Japanese Volcanoes in the February number of the *Journal*, points out the following errata as occurring in the article as printed: On p. 194, line 2, "distinct" should read "extinct," and on line 3 of the last paragraph, "wall crater" should be "crater wall." The title to the upper illustration on 196 should read "Bandaisan from Lake Inawashiro," and in the last paragraph on p. 198, line 4, "Hindo" should be "Hondo." He also states, with reference to the parenthesis in the last line of p. 190 and first of 191 (which was not in the manuscript of the article), that the "descriptions" referred to were, with few exceptions, translations from more or less unreliable Japanese sources, and that, even in the case of volcanoes visited by the author, serious discrepancies occur.

AFRICA.

M. Gentil's Geological Researches in Morocco.—This traveller, whose former work has from time to time been referred to in the *Journal*, continued his examination of the geology of portions of Morocco during 1907, though the events of which the country has been the scene prevented him from carrying out his original programme. This was to have led him once more to the Atlas south of Marakesh, in which city he had planned to instal a meteorological observatory, as a check on his determination of altitude in the mountains. But having arrived at Marakesh on March 12, the assassination of Dr. Mauchamp soon afterwards made it necessary to abandon further attempts in this direction. M. Gentil turned his attention instead to the borderland on the side of Algeria, carrying out also some geological researches in the neighbourhood of Tangier and near the Atlantic coast (*Renseign. Colon., Com. Afrique Française*, 1908, No. 2). In the Tangier region he found that the Pliocene sandstones which form the very regular plateau of the Rarbya, between the Wed Kharub and the coast, are identical in *facies* with those examined by him in 1885 near Tetuan, and he draws important conclusions as to the history of the Strait of Gibraltar. This must, he holds, have already been open at the time of the deposition of these Pliocene sandstones, the former communication (early Miocene) between the Mediterranean and Atlantic north of the Sierra Nevada having by the end of that period been displaced to the south of the Rif. Here, as in the other districts examined, he paid special attention to the question of water-supply, and was able to determine the geological position of the water stratum. In the "Rarb" district near Casablanca, he found that the Pliocene sandstones rest on a sub-stratum of Silurian and Devonian age, but on the Algerian frontier the formations represented are much more varied, including strata of Primary, Secondary, and Tertiary age. Two distinct series of folds were here observed, an older of Hercynian, and a more recent of Alpine type. Results of volcanic activity from the Carboniferous age onwards were also found. M. Gentil thinks that water might be obtained for irrigation purposes in the neighbourhood of Ujda, where some at least of the soil seems likely to prove fertile.

The Western Coasts of the Red Sea.—Professor Herdman has communicated to the *Journal of the Linnean Society* (December 21, 1907) a series of reports on the results of investigations into the marine biology of the Sudanese Red sea, carried out under his direction in 1904 by Mr. Cyril Crossland. Some of the reports deal with special portions of the biological collections, but Mr. Crossland's own narrative of the expedition, and discussion of certain of the features of the coasts visited, are of interest from a geographical point of view. Several weeks were spent at Suez, the marine fauna of which is typically tropical, affording a distinct contrast with that previously studied by Mr. Crossland on the other side of the continent during his expedition to the Cape Verde group. Voyaging hence

down the Red sea, in a small vessel, he was able to see many little-known harbours and reefs on the western shores, especially between $21^{\circ} 30'$ and 18° N., and was struck with the uniformity of the biological conditions. Of all seas this best deserves the name Coral sea, as (with one partial exception) corals luxuriate everywhere. The exception is formed by the large enclosed bay of Dongola or Dongonab, where a submarine bar separates a coral area to the south from a nullipore area to the north. The absence of coral in the latter cannot be explained by any of the causes which in general restricts its growth, and Mr. Crossland suggests that if the reason could be found it might throw light on the unexplained absence of reef-forming coral on parts of the East African coast. A special report deals with the coral reefs of the Sudanese coast. As in other parts of the Red sea the rift valley is here bounded by ranges of jagged mountains of granite and the crystalline rocks, between which and the sea is a plain of alluvial gravel and sand, traversed in places by ranges of low hills. A striking feature is the number of canal-like bays or "khors" running into the coast plain. They have been attributed to two series of faults at right angles to each other, and their permanence is no doubt due to the almost rainless climate, the absence of strong tidal currents, and the protection afforded by growing coral. Both fringing and barrier reefs are represented, as well as scattered reefs—some of atoll form. Many evidences of recent elevation are to be seen in the form of raised beaches and old erosion lines or cliffs, and Darwin's subsidence theory cannot therefore be adopted in explanation of the barrier reefs or atoll-like forms. Mr. Crossland regards the forms of the reefs as due to the balance between aggrading and degrading agents, the former being the growth of coral, nullipores, etc., the latter the corrosive action of the sea and the rotting caused by boring organisms. A note is also given on the shore-cliff near Alexandria, which is composed of wind-blown sand (broken shell material), passing lower down into sandstone of considerable hardness. Between high and low water there is a rock-flat, which seems to owe its origin to the hardening action of the sea water. Below water-level its edge is protected by an incrustation caused by marine organisms.

Captain Percival's Surveys in the Bahr-el-Ghazal.—With reference to the article on this subject in the *Journal* for December, 1907 (p. 604), Captain Claud Percival, the officer whose surveys were there described, writes to point out that it was a mistake to credit him with the earlier survey work carried out in association with Lieut. Bayldon, R.N. (also referred to by Lieut. Comyn in the November number, p. 524). This was done by Captain A. B. Percival, D.S.O., of the Northumberland Fusiliers—an officer with a distinguished career both in South Africa and the Sudan. In the map accompanying the same article, the hills south of Ragaa should have been named Mungaiyat, not Mungalyat.

AMERICA.

Retreat of Glaciers in the Canadian Rockies.—We understand that Messrs. G. and W. S. Vaux (whose report on observations of certain glaciers of Alberta and British Columbia in 1906 was printed last year in the *Proceedings of the Academy of Natural Sciences of Philadelphia*) have lately reported to that Academy on the results of further work carried out in 1907. As in 1906, the observations have shown that the retreat of the glaciers of this region, which has been in progress for some time, continues to make itself noticeable—in fact, the shrinkage and breaking down of the glacier-tongues were increasingly marked in 1907. The tongue of the Illecillewaet glacier, when examined on August 12 last, was found to have receded 55 feet since July 24, 1906 (if measured along a line parallel with the axis of the glacier). A similar state of things was observed, on August 15, at the Asulkan glacier, the changes being here more marked than

for several years. At the Victoria glacier the changes were less marked, though still in the same direction. On August 19 the Yoho glacier was found to have receded very appreciably during the previous twelvemonth, particularly on the left side. As in other examples, the point of greatest extension was a very long, blade-like tongue occupying one of the grooves in the glacier-bed, parallel to its direction of flow. The above facts are the more remarkable, as the winter of 1906-07 had been cold and stormy, and the following summer showed a low average of sunshine and low temperature conditions. Further study is evidently necessary before the relation between weather conditions and glacier changes can be fully understood.

The Great Salt Lake.—We have received the following note from Mr. F. Trimmer, who for some years has paid attention to the fluctuations of this lake (cf. *Journal*, vol. 18, p. 97): "A note appears in the *Salt Lake Tribune* of February 21 that the latest observations of the U.S. Weather Bureau local officials find the level of the Great Salt lake at that date to be 3 feet 6 inches above zero. This level was not reached in 1907 until midsummer. That would be after the snows had come down the rivers, and it was the highest reading for ten years. Some three or four years ago one came across newspaper articles from time to time lamenting the approaching demise of the Great Salt lake, the level having been falling for so long. But the outlook to-day seems different. It will be interesting to learn later about the 'cut-off' built on piles during this low-water period by the Central Pacific Railway for 10 miles across the shallows of the northern end of the lake at a height said not to contemplate the waters again rising. The statement is made that a further rise of 2 feet in the lake will submerge the rails. Bearing in mind the steadily increasing diversion for irrigation of all streams feeding the Great Salt lake, this rise now under observation seems to be of unusual interest."

Exploration in Matto Grosso, Brazil.—The work, now in progress, for the construction of a telegraph line through the west of the state of Matto Grosso, seems likely to supply some useful information on the geography of this imperfectly known region. A report by Major Candido Rondon, leader of the military commission to which the work has been entrusted, is quoted in the third number of the *Zeitschrift* of the Berlin Geographical Society for the present year (p. 193). Major Rondon had, at the time of sending off his despatch, lately returned to Diamantino from an expedition to the Yuruema, one of the main headstreams of the Tapajoz, which he had reached in 13° S. During the march north he had crossed the almost treeless plain on which all the upper branches of the Tapajoz have their sources, and had fixed the positions of sixteen of the tributaries of the Yuruema. Three tribes of Indians—the Paresis, Cabexis, and Nyambiquiras—were encountered, and the party had to resist an attack, probably from the Nyambiquiras, with whom the rubber collectors who frequent this region have for some time been at feud. The view from the summit of the Tapirapuinsan range showed a succession of terraces rising into a mountain chain, which apparently forms the water-parting between the basins of the Guapore, Paraguay, and Tapajoz. The greater part of the region consists of sand, with a substratum of sandstone, but considerable differences in the vegetation were observable on crossing the water-parting.

POLAR REGIONS.

MacClure's Ship, the "Investigator."—It is reported from America that the *Investigator*, which was abandoned by MacClure in 1853 when ice-bound in its winter quarters on the north side of Banks Land, was last summer visited by the

whalers, who found the ship in good preservation, and, owing to the unusual freedom of the coast from ice, were able to tow her away. If the story be correct, the return to civilization of a ship that has remained ice-bound in the far north for over half a century, will be a unique event in the history of exploration.

The Drift-cask Experiment.—An inquiry addressed to the Philadelphia Geographical Society has elicited the fact that, in addition to the casks of which the discovery had been previously reported, another of those cast adrift for the purpose of determining the direction of polar currents has been recovered. This was No. 50 of the series, and it had been dropped by Captain Tuttle on August 21, 1901, in lat. $72^{\circ} 5' N.$, long. $171^{\circ} 33' W.$ It was found in August 1903, by a native of Ammen, 8 miles south-east of Cape North, Siberia, having thus reached land at no great distance from its starting-point, Cape North lying only just west of 180° from Greenwich. The general direction of drift must thus have been south-west, on the supposition that the course taken was fairly direct. The following are the positions at which other casks were cast adrift:

Nos. 1, 2, 8	in $70^{\circ} 47' N.$, $126^{\circ} 3' W.$
„ 22	„ $70^{\circ} 35' N.$, $120^{\circ} 35' W.$
„ 24	„ $70^{\circ} 52' N.$, $125^{\circ} 35' W.$
„ 26	„ $71^{\circ} 0' N.$, $128^{\circ} 5' W.$
„ 38	„ $70^{\circ} 50' N.$, $123^{\circ} 5' W.$

Mr. Mikkelsen's Expedition.—The news was telegraphed from Seattle on April 3 that Mr. Mikkelsen had arrived there the previous day from Alaska. He had left Flaxman island on October 16, and journeyed along the northern shore of Alaska towards Nome, afterwards proceeding along the Yukon towards Fort Gibson, and coming out by way of Fairbanks and Valdez. Mr. Leffingwell, the geologist, remained at Flaxman island to continue the scientific work. It is stated that Mr. Mikkelsen is hoping to obtain further funds to enable him to prosecute his task.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Fluvial and Glacial Erosion.—An article by Prof. Brunhes in the *Revue de Géographie* is called forth by a paper read by Prof. W. M. Davis at the meeting of the British Association in 1905, and published in the *Scottish Geographical Magazine* in the following February. Prof. Brunhes accepts as correct the difference between valleys excavated by fluvial and glacial erosion—the U form of the latter and the over-deepening of the main valley, but ascribes the result in great measure to the action of water beneath the glaciers and not to the direct erosion of ice. He points out that the U-shaped bottom of some valleys, such as that of Lauterbrunnen, is formed of *débris* that has fallen or been carried down by water, and that the vertical cliffs show no signs of abrasion by ice. He refers to the frequency of bars and bosses of rock in glaciated valleys and the rocky knobs often rising in the midst of existing glaciers which are known in Switzerland as *Platten*. By these the subglacial water is diverted into two or more streams, and hence the bed of the glacier is broadened and assumes the U form. Where the glacier is contracted or tapers off at its extremity the two streams run together, and the valley, after the retreat of the glacier, approaches rather to the V than the U form. The ice plays its part in rounding off and polishing the furrows washed out by the water and grinding down all salient points. It reduces the ridge between the streams, sometimes removing it altogether, or leaving only bars and knolls here and there. The excavation of these valleys is, therefore, according to Prof. Brunhes, commenced by water directed and controlled by glaciers, and is completed by the action of the ice.

The Relative Levels of the Land and Sea.—The view of Suess, that the sea-level has remained virtually constant during the recent geological period, and that any disturbance of the relative levels of land and sea must be due to local movements of the land, is pretty generally accepted by geologists. The contrary view has found, however, a champion in M. P. Négri, who has written various papers on recent changes of level in the Mediterranean region, which changes, he holds, point to a general rise in the level of the sea within historic times (Cf. *Journal*, vol. 24, p. 483). From his researches at Delos, Prof. Cayeux was led to doubt the conclusions of M. Négri, who has therefore himself made an examination of that island with a view to testing M. Cayeux's propositions. The results, which he has lately published as a brochure (Athens: Charles Beck; Paris: C. Béranger, 1907), have only tended to confirm him in his previous opinion, and he maintains that both the natural shore features and the position of ancient edifices now bathed by the sea indicate a recent rise in the level of the latter. M. Négri supports his contention by many other instances of submerged buildings within the Mediterranean region, these having, in his opinion, all been constructed at a time when their sites were raised above the sea-level. The wide distribution of such partially submerged buildings might seem to favour M. Négri's view, though it may be asked whether there are no recorded facts which tell in the opposite direction. While it is quite probable that a swelling up of the beds of some of the seas may have taken place, as M. Négri supposes, it is difficult to believe that such movements could be so general and similar in direction as to affect the level of the ocean as a whole; for a sinking of the sea-bed, under the weight of sediment deposited on it, is rather to be expected, in places at least. Were the Mediterranean an entirely closed sea, there would be less difficulty in accepting the theory as regards this particular region, but M. Négri supposes that a similar rise in the sea-level has taken place on the oceanic coasts of Western Europe.

Sea-water and the Germination of Seeds.—In any study of the distribution of plants the question of the dispersal of their seeds by the agency of the sea is, of course, an important one, rendering it necessary to know how far the seeds of various species may retain their vitality after long immersion. Practical experiments with this object have been made by a good many observers, including Darwin, though it is difficult to secure the reproduction of natural conditions in such experiments. Mr. Selim Berger, of Stockholm, whose study of the colonization by plants of newly formed islands in one of the Swedish lakes was referred to in a recent number of the *Journal* (January, 1908, p. 111), has carried out perhaps the most methodical series of experiments of this kind that has yet been made. Having procured the seed of a number of species (some Scandinavian, some from the Falkland islands), he subjected a fixed number of each kind to thirty days' immersion, under otherwise similar conditions, both in fresh and salt water, afterwards placing both alike in a darkened room, between layers of moistened filter-paper, while samples of the same seeds, collected at the same time but not previously immersed in water, were treated in a similar way. The seeds were examined daily for a complete year. Mr. Berger has described the experiment and its results in the *Beihefte zur Botanischen Centralblatt* (Dresden, 1907), and has sent us a reprint of the paper. As might be expected, different seeds (of twenty-six separate kinds subjected to the experiment) behaved in very different ways, and differences were observed according to the three different modes of treatment. Thus, while some germinated freely before being removed from the water, in the case of others this happened only during the subsequent treatment, while in a few cases all the seeds (in one or other of the categories) failed to germinate within the year. A comparison of the fate of the seeds immersed in salt, with that in fresh water, shows

that in the case of certain species the salt water had increased the percentage of those germinating, though in others the reverse held good. In some cases also the immersion, whether in salt or fresh water, had caused a larger percentage to germinate than was the case with the seeds not immersed at all. Of importance as regards the dispersal of plants by ocean currents is the fact that while the seeds of some species remained floating throughout the period of immersion (some germinating in this position), those of other kinds all sank, either at once or within a very short time. It is noteworthy also that a considerable proportion of the seeds of some species (whether immersed or not) remained "hard," or apparently capable of germination, at the end of the whole year.

HISTORICAL GEOGRAPHY.

Early Cartography of the Baltic.—Some interesting notes on this subject are given by Prof. V. Bellio in the *Rivista Geogr. Italiana* for November, 1907. The writer makes no attempt to treat the subject exhaustively, but devotes his attention chiefly to the early Italian and Catalan portolani, and the probable sources whence they derived their knowledge of the Baltic. At the outset he discusses briefly the question of the priority of the Italians or Catalans as makers of nautical charts, and upholds the claims of the former as against the views of Hamy and others. Without accepting the suggestion of Magnaghi that Dalorto and Dulcert (which last he prefers to read Dolceti) may have been one individual, he holds that the latter may quite as probably have been of Italian as of Catalan origin. In regard to the mapping of Northern Europe, he equally dissents from the view of Hamy that any knowledge of this region possessed by the Mediterranean peoples in the early fourteenth century came solely through the Spaniards, showing that the Genoese were probably well acquainted with the seas at least as far as Flanders. While many of the early portolani omit the Baltic altogether, and others, from Carignano onwards, show it merely in diagrammatic form, the charts of Dalorto, Dolceti, the Laurenziana Gaddiana, and the Catalan of 1350 (?) and 1375 (all belonging to one type in this respect) make some attempt to represent its outlines, though with very partial success. As a possible source of this delineation, Prof. Bellio quotes the description of Adam of Bremen, which shows a somewhat striking agreement with it as regards the main features. He also refers to the configuration given to the region of the Baltic in maps of a type found in early manuscript or printed versions of Ptolemy's Geography, and is inclined to attribute it to information obtained by Marino Sanuto about 1320. Curiously enough, he makes no special reference to the map of Claudius Clavus, to which some of the later examples were almost certainly indebted, and which might far more suitably have appeared in his fourth than in his second category. In the latter part of his paper he discusses two of the early sources for a knowledge of the Baltic, viz. the 'Itinerary of Bruges' and the 'Navigatio ex Dania per Mare Balticum ad Estoniam,' laying down the data supplied by these on a map, in which the actual coasts are also shown, as well as those derived from Dalorto. The Italian cartographers evidently made little if any use of these sources. It may be noted that the Venice map of 1514, of which a reproduction appeared in the February number of the *Journal*, gives, for the time, an unusually good indication of the Baltic.

GENERAL.

Geography and Architecture.—An interesting note on this subject appears in the *Building News and Engineering Journal* (vol. 93, No. 2752). It is pointed out that the great styles of architecture have always had their geographical centres, whence they have spread with wider trade routes and commercial and

political development. They were created in wealthy countries during long years of peace, with little interference from outside. In the hands of a rich aristocracy money was freely devoted to great buildings. This was the case in the cities of Greece. The routes of East and West met here—the caravan path over the desert through Tyre and Egypt, by way of Greece, to Sicily and South Italy, and the sea routes from all parts of the Mediterranean. The external contact was not too close: development was untainted with foreign styles. The supply of Pentellic marble was very large, and all the great buildings arose in times of peace. The reaction of Grecian architecture was traceable as far as north-west India, especially after the march of Alexander. In Rome, architecture developed during centuries of peace: it spread as the legions subdued the Mediterranean coasts, and followed their march along the great rivers of the north-west, especially the Rhine. After Rome fell, Constantinople became the trading centre of the world, and the Byzantine style spread eastward and westward along the old trade routes, and also through Russia. Venice, from the head of the Adriatic, was able to assimilate and disseminate. These two types of Romanesque were drawn towards Paris, but the coastal ravages of Scandinavians influenced this style, so that it gave birth to the Norman architecture. The insularity and internal peace of England left her free to perfect the Gothic style—slightly affected by the Crusades. Geographical position favoured the buildings of the Belgian towns, where trade brought riches and popular appreciation. The Italian republics of Florence, Venice, and Rome were separated by the Apennines, so that each built its distinct semi-fortress type. With the growth of means of communication the styles of China, India, and Japan are being Europeanized, with modifications due to climatic differences. Western effects are more visible in domestic work than in the great monuments.

A Dutch Society for the Publication of Early Voyages.—A society on the lines of the Hakluyt Society has been formed in Holland, to be called the "Linschoten Society." There is a large amount of available material, and the society is likely to bring much useful geographical information to our knowledge, and to have a highly interesting career. The first council will consist of: President, Jonkheer Vice-Admiral A. J. Roell; Vice-president, J. E. Heeres, Professor at Leyden; secretary, Wouter Nijhoff; treasurer, D. F. Scheurleer; other members, Dr. H. T. Colenbrander (secretary to the Government Commission for the Publication of Records), A. Hotz, Captain Baron Mulert (Royal Navy), G. P. Rouffaer.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907-1908.

RESEARCH DEPARTMENT.

March 20, 1908.—Major C. F. CLOSE, C.M.G., R.E., in the Chair.

The paper read was—

"The Regional Geography of the Land's End Peninsula." By A. W. Andrews.

Tenth Meeting, March 27, 1908.—Sir COLIN SCOTT-MONCRIEFF, K.C.M.G., K.C.I.E., Vice-President, in the chair.

A lecture was given on "A Canoe Journey to the Plains of the Caribou." By Ernest Thompson Seton.

Eleventh Meeting, March 30, 1908.—The Right Hon. Sir GEORGE T.

GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*Frederick Stanley Arnot; Louis Becke; Hon. Lewin Cadogan; Francis Edward Clarke; Neville B. Craig; John Percival Day; Dr. T. T. Groom, M.A.; Colonel John Matthew Jones (Army Medical Service); Cuthbert Francis Montagu; Chas. Henry Duncan Morland, M.D.; Hon. Charles S. Rolls; Edgar Campbell Russell; Albert Russell; Richard Stanley Harley.*

The paper read was:—

"Geographical Conditions affecting the British Empire. (1) British Islands."
By H. J. Mackinder.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., Librarian, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Académie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Is. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.

Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selakab.
So. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 x 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

- Alps.** Z. Ges. E. Berlin (1908): 5-17. Penck.
Die Entstehung der Alpen. Von Albrecht Penck. *Diagrams.*
- Alps—Historical.** M.k.k.G. Ges. Wien 50 (1907): 293-311. Reber.
Zur Frage des Aufenthaltes der Hunnen und Swazenen in den Alpen. Von B. Reber.
- Alps—Monte Rosa.** *Jahrbuch Schweizer-Alpenclub* 42 (1906-07): 253-272. Täuber.
Zur Bergnamenforschung. (Noch einmal "ros", "ross.") Von Dr. C. Tauber.
Illustrations.
- Austria—Carinthia.** M.k.k.G. Ges. Wien 50 (1907): 534-645. Till.
Das grosse Naturereignis von 1848 und die Bergstürze des Dobratsch. Von Dr. Alfred Till. *Sketch-maps and Sections.*
- Austria—Karat.** *Globus* 92 (1907): 359-365, 377-383. Perko.
Aus der Unterwelt des Karates. Die Schlundhöhle von Bresovizza, die Tropfsteinhöhle von Sliono und die Moserhöhle bei Nabresina. Von G. And. Perko.
Plans, Sections, and Illustrations.

- Austria—Karst.** **Beck v. Mannagetta.**
Sitzungsber. K.A.W. Wien 115 (1906): I. Abt., 3-20.
 Die Umkehrung der Pflanzenregionen in den Dolinen des Karstes. Von Günther Ritter Beck v. Mannagetta. *Illustrations.*
- Austria—Silesia.** *M.h.k. G. Ges. Wien* 50 (1907): 312-324. **Hanlik.**
 Die Eiszeit in den Schlesienschen Beskiden. Von Dr. Erwin Hanlik.
- Austria—Tirol.** *Z. Gletscherkunde* 2 (1907): 29-54, 112-127. **Ampferer.**
 Glazialgeologische Beobachtungen im unteren Inntale. Von Dr. Otto Ampferer. *Map and Sections.*
- Balkan Peninsula—Geology.** **Stroh.**
 Die geographische Verbreitung von Eiszeitspuren auf der aussergriechischen Balkanhalbinsel in ihrer Abhängigkeit von Niederschlagsmenge und Höhe. Dissertation . . . von Franz Stroh. Darmstadt, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, 58. *Map and Diagrams.*
- Central Europe—Erzgebirge.** **Straube.**
 Die höchsten Siedelungen des sächsisch-böhmischen Erzgebirges. Inaugural-Dissertation . . . von Otto Straube. [Leipzig, 1906.] Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 110. Price 1s. 9d.
- Danube.** **Trotter.**
 Commercial, No. 9 (1907). Despatch by Lieut.-Colonel Sir Henry Trotter, reporting upon the operations of the European Commission of the Danube during the years 1894-1906, together with a *résumé* of its previous history. London, 1907. Size $13 \times 8\frac{1}{2}$, pp. 8. *Plans.* Price 6d.
 On the various improvements to navigation, etc.
- England and France—Cartography.** **Fordham.**
 Notes sur la cartographie des provinces anglaises et françaises des seizième et dix-septième siècles. Par Herbert George Fordham. Ghent, 1907. Size 9×6 , pp. 10. *Facsimiles.*
 The author has been for some time a keen student of local English cartography, and has lately turned his attention to that of France.
- Europe—Meteorology.** *Meteorologische Z.* 25 (1908): 1-9. **Trabert.**
 Die langdauernde Föhnperiode im Oktober 1907 und die Luftdruckverteilung bei Föhn. Von Wilhelm Trabert. *Diagrams.*
- Iceland.** *Z. Ges. E. Berlin* 1907: 597-621. **Pjetursson.**
 Einige Ergebnisse seiner Reise in Süd-Island im Sommer 1906. Von Dr. Helgi Pjetursson. *Sections.*
- Italy—Sardinia.** *C.R.A. Sc. Paris* 145 (1907): 1312-1313. **Deprat.**
 Sur un cas de dédoublement du thalweg d'une vallée par l'intervention d'une coulée volcanique (Sardaigne). Par Deprat.
- Italy—Vesuvius.** *Riv. G. Italiana* 14 (1907): 385-395. **Baratta.**
 Il nuovo rilievo del cono vesuviano. Di Mario Baratta. *Sketch-map.*
- Norway—Coast.** **Holland-Hansen.**
 De vestlandske Østersbusinens naturforhold. Af B. Holland-Hansen (Meddelelser om Østersavlen, III.). Bergen, 1907. Size 9×6 , pp. 110. *Map, Diagrams, and Illustrations.*
- Pyrenees—Place-names.** *B.G. hist. et descriptive* (1907): 73-192. **Belloc.**
 Déformations des noms de lieux pyrénéens. Par Émile Belloc.
- Russia—Hydrology.** **Yermoloff.**
Spelunca, B. and Mém. S. Spéologie 7 (1907): No. 49, pp. 20.
 Les lacs intermittents de la Russie d'Europe. Par A.-S. Yermoloff. *Maps and Illustration.*
 See April number, p. 441.
- Scandinavia.** **Bihot.**
 La rupture scandinave: étude anthropogéographique. Par Charles Bihot. (Travaux du Séminaire de Géographie de l'Université de Liège, fascicule 8.) Liège, 1907. Size 9×6 , pp. 46.
- Sweden—Place-names.** *Ymer* 27 (1907): 228-238. **Noreen.**
 K. Ortnamnskommitténs arbeten. Af Adolf Noreen.

United Kingdom—Ireland. *Geol. Mag.*, Dec. V., 4 (1907): 549-553. **Reed.**
Notes on some Coastal Features in Co. Waterford. III. Tramore Bay to Dunmore East. By F. R. Cowper Reed. *Section*.

United Kingdom—River-systems. **Harmer.**
Quarterly Journal Geol. S. 63 (1907): 470-514.

On the origin of certain cañon-like valleys associated with lake-like areas of depression. By Frederic William Harmer. *Maps, Illustrations, and Sections*.

Noticed in the February number, p. 215.

United Kingdom—Scotland **Lewis.**

The Plant Remains in the Scottish Peat Mosses. Part iii. The Scottish Highlands and the Shetland Islands. By Francis J. Lewis. (From the *Transactions of the Royal Society of Edinburgh*, vol. 46, part i. (No. 2).) Edinburgh, 1907. Size $12\frac{1}{2} \times 9\frac{1}{2}$, pp. [33-70]. *Map and Sections. Presented by the Author*.

This and the earlier parts have been noticed in the *Journal* (vol. 27, p. 84; vol. 30, p. 88; vol. 31, p. 331).

United Kingdom—Scotland. **Chrystal and Murray.**

T.R.S. Edinburgh 45 (1905-1907): 361-396.

An investigation of the seiches of Loch Earn by the Scottish Lake Survey. Part i., by Prof. G. Chrystal; part ii., by James Murray. *Illustrations and Diagrams*.

Western Europe. **Cambier.**

B.S.R. Belge G. 31 (1907): 40-91, 126-170, 252-288, 319-383.

Études sur les transformations de l'Escaut et de ses affluents au nord de Gand pendant la période historique. Par E. Cambier. *Map*.

ASIA.

Caspian Sea. **B American G.S.** 39 (1907): 577-596. **Huntington.**

The historic fluctuations of the Caspian Sea. By Ellsworth Huntington. *Map and Diagram*.

A chapter from the author's work, 'The Pulse of Asia.'

Central Asia. **G.Z.** 13 (1907): 568-579. **Berg.**

Ist Zentral-Asien im Austrookren begriffen? Von L. Berg.

The writer believes that the "geological" desiccation of Central Asia has long ceased, and that the existing state of things is an alternation of wetter and drier periods.

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The pulse of Asia: a journey in Central Asia illustrating the geographic basis of history. By Ellsworth Huntington. London: A. Constable & Co., 1907. Size 9×6 , pp. xxiv. and 416. *Maps and Illustrations. Price 14s. net. Presented by the Publishers.* [To be reviewed.]

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Index de la section géographique de la Grande Encyclopédie chinoise, T'ou-chou-tch'eng. Par C. de Waeber (K. I. Weber).

China—Central. **B S.R. Belge G.** 31 (1907): 289-348. **Harfeld.**

Itinéraires dans le Hou Nann nord-occidental et dans le Kiangsi occidental. Par le Capitaine F. Harfeld. *Map and Illustrations*.

See note in the March number (p. 334).

China—Transliteration. **Hirth.**

Syllabary of Chinese sounds. By Friedrich Hirth (Extracted from 'Research in China,' vol. 1, part ii.) Washington, 1907. Size $11\frac{1}{2} \times 9$, pp. 511-528.

China—Yangtze basin. **Z. Ges. E. Berlin** (1907): 589-596. **Wegener**

Ueber seine Reise in Mittel-China. Von Dr. Georg Wegener.

See note on a part of the journey in vol. 30, p. 211.

Chinese Empire. **Kennelly.**

A list of the cities, towns, and open ports of China and dependencies. By M. Kennelly. Shanghai: T'uswei Press, 1908. Size $9\frac{1}{2} \times 5\frac{1}{2}$, pp. viii. and 84. *Price 3s. 6d.*

Chinese Empire—Tibet. **Z. Ges. E. Berlin** (1908): 18-35. **Filchner.**

Seen in Nordost-Tibet und das Matschu-Problem. Von Wilhelm Filchner. *Diagrams and Illustrations*.

Chinese Empire—Turkestan.**Le Coq.**

Bericht über Reisen und Arbeiten in Chinesisch-Turkistan. Von A. v. Le Coq. (Aus der Zeitschrift für Ethnologie, Heft 4 u. 5, 1907.) Size 10 x 6½, pp. 509-524. *Illustrations.*

On the German archaeological expedition to Central Asia.

Chinese Turkestan. B.A. Impériale Sc. St. Petersburg (1907): 805-818.**Oldenburg.**

Summary list of antiquities found in Turfan by Dr. Kokhanskii. By S. F. Oldenburg. *Illustrations.* [In Russian.]

French Indo-China.

Géographie physique, économique, et historique de la Cochinchine: x-xliii fascicules. Monographies des provinces de Càn-Tho' (pp. 38), Soc-Tràng (pp. 84), Longxuyén (pp. 42), et de l'île de Phú-Quôc; province de Hàtién (pp. 32). Saigon, 1904-06. Size 10 x 6½. *Maps. Price 2s. each.*

French Indo-China—Cambodia.

Géographie physique, économique et historique du royaume de Cambodge; 1^{re} fascicule. Monographie de la province de Pursat. Saigon, 1906. Size 10 x 6½, pp. 66. *Price 2s.*

India—Himalayas. Records Geol. Surv. India 35 (1907): 148-157. Cotter and Broun.

Notes on certain glaciers in Kumaon. By G. de P. Cotter and J. Coggin Broun. *Sketch-maps and Illustrations.*

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Notes on certain glaciers in Lahaul. By H. Walker and E. H. Pascoe. *Sketch-maps and Illustrations.*

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The Percy Sladen Trust expedition to the Indian Ocean in 1905, under the leadership of J. Stanley Gardiner. Description of the expedition, Ceylon to Mauritius; and Reports, Nos. 2-8 (From the *Transactions of the Linnean Society*, Ser. ii., vol. 12, part 1.) London, 1907. Size 12 x 9½, pp. 1-110. *Map and Illustrations.* Presented by Mr. J. S. Gardiner.

India—Survey.

General report on the operations of the Survey of India . . . during 1905-06, prepared under the direction of Colonel F. B. Longe. Calcutta, 1907. Size 13 x 8½, pp. iv and 56. *Maps and Illustration.*

Among special operations carried out during the year were vertical observations of Himalayan peaks from stations near Dehra Dun (cf. January number, p. 103), and pendulum observations between Simla and Quetta.

Malay Archipelago—Borneo.**Walchren.**

Ts. K. Nederlandsch Aard. Genoots. 24 (1907): 755-844.

Eene reis naar de bovenstrekken van Boeloengan (Midden-Borneo) (12 Nov. 1905-11 April, 1906). Door E. W. F. van Walchren. *With Map and Illustrations.*

Malay Archipelago—Sumatra.**Cornelis.**

Ts. K. Nederlandsch Aard. Genoots. 24 (1907): 1030-1047.

Een poging tot verbetering der kaarten van Noord-Sumatra. Door W. Cornelis.

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Ts. Indische Taal-, Land-, en Volkenkunde 50 (1907): 147-185.

Bericht über die zweite Untersuchungsreise nach der Insel Engano. 4. October bis 19. November 1904. Von Dr. Johs. Winkler.

Persia—Desert.

J. Manchester G. S. 23 (1907): 60-76.

Sykes.

The Lut, the Great Desert of Persia. By Herbert R. Sykes.

Russia—Caucasus.**Markovich.**

Mém. Imp. Russ. G. S., Gen. G. 36 (1906): No. 3, pp. 222.

To the sources of the Ardon and Rion rivers. By V. V. Markovich. *Illustrations.* [In Russian.]

Russia—Siberia.**Bogoras.**

The Chukchee. By W. Bogoras. II. Religion. (Publ. Jesup North Pacific Expedition, vol. 7, part 2.) Leiden and New York, 1907. Size 14 x 11, pp. 277-536. *Illustrations.*

Turkey—Arabia.

B. American G. S. 39 (1907): 597-606.

Zwemer.

Oman and Eastern Arabia. By S. N. Zwemer. *Sketch-map and Illustrations.*

Turkey—Asia-Minor.*Sitzungsber. K.A.W. Wien* 115 (1907): 241-262, 1757-1769.**Grund.**

Vorläufiger Bericht über physische Untersuchungen in Delta-gebiet des Kleinen Mäander bei Ajasoluk (Ephesus). Von Dr. A. Grund. *Map*.

AFRICA.**Abyssinia.***B.S.G. Italiana* 9 (1908): 7-84, 122-137.**Castro**

Un' escursione al monte Zuquala, al lago Zua e nei Soddo. Note di viaggio del dott. Lincoln de Castro. *Map and Illustrations*.

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Meteorological Office, No. 162. Hints to meteorological observers in tropical Africa, with notes on methods of recording lake-levels, and a memorandum on the organization of meteorological observations. London, 1907. Size $9\frac{1}{2} \times 6$, pp. 36.

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Algérie: Les territoires du Sud. Par A. M. *Map*

Cf. note in the February number, p. 220.

Algeria and Morocco—Frontier.**Asan.**

La frontière algéro-marocaine au début de 1907. Par l'aul Azan. Tonnerro, 1907. Size $10\frac{1}{2} \times 7$, pp. 28.

Canary Islands.*Globus* 92 (1907): 325-331, 343-348.**Knebel.**

Der vulkanische Aufbau der Insel Gran Canaria. Von Dr. Walther von Knebel. *Map, Illustrations, and Sections*.

Congo State—Ethnology.**Acker.**

Annales du Musée du Congo: Ethnographie—Serie V. Dictionnaire Kitabwa-Français et Français-Kitabwa. Par le R. P. Auguste von Acker. Brussels, 1907. Size $14\frac{1}{2} \times 10\frac{1}{2}$, pp. 170.

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Annales du Musée du Congo: Ethnographie et Anthropologie—Serie III. Notes analytiques sur les collections ethnographiques du Musée du Congo. Tome II.: Les industries indigènes. Fascicule I. Brussels, 1907. Size $14\frac{1}{2} \times 10\frac{1}{2}$, pp. 1-194 and I.-iv. *Illustrations*.

Egypt.**Garstin.**

Public Works Department. Reports upon the Administration of the Irrigation Services in Egypt and in the Sudan for the year 1906. By Sir W. Garstin. Cairo, 1907. Size $11 \times 7\frac{1}{2}$, pp. 58. *Plan, Diagram, Illustrations, and Sections*.

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Survey Department, Egypt. A catalogue of maps exhibited in the Geological Museum, January 9-18, 1908. Cairo, 1908. Size $11 \times 7\frac{1}{2}$, pp. 30.

Egypt—Cotton.**Willcocks.**

Nile reservoirs and the cotton crop. By Sir William Willcocks. Cairo, 1907. Size $10\frac{1}{2} \times 7$, pp. 20.

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Nilmeasser und Nilstandsmarken. Von Dr. Ludwig Borchardt. *Sections*.

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Survey Department, Egypt. A description of the first or Aswan cataract of the Nile. By Dr. John Ball. Cairo, 1907. Size 11×7 , pp. 122. *Maps and Illustrations*.

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Survey Department, Cairo. The topography and geology of the Peninsula of Sinai (south-eastern portion). By Dr. W. F. Hume. Cairo, 1906. Size $10\frac{1}{2} \times 7$, pp. 280. *Maps and Illustrations*.

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Survey Department, Egypt. The history of surveying and land-measurement in Egypt. By Captain H. G. Lyons. Cairo, 1907. Size $10\frac{1}{2} \times 7\frac{1}{2}$, pp. 36.

Egyptian Sudan—Survey.**Pearson and others.**

Notes on the marking out of the Gezira, in the Anglo-Egyptian Sudan, into

minutes of Latitude and Longitude. By Captain H. D. Pearson, W. L. Crompton, and S. M. Vines. London: Eyre & Spottiswoode, 1907. Size $10\frac{1}{2} \times 7\frac{1}{2}$, pp. 28. *Maps and Illustrations. Presented by D. Cameron-Swan, Esq.*

German East Africa.

Pfeil.

Zur Erwerbung von Deutsch-Ostafrika: Ein Beitrag zu seiner Geschichte. Von Dr. Joachim Graf v. Pfeil. Berlin: K. Curtius, 1907. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 232. *Illustrations. Presented by the Author.*

German East Africa—Boundaries.

Ambrohn.

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Bericht über das astronomischen und geodätischen Arbeiten, welche zur Festlegung der Grenze Deutsch-Ostafrikas gegenüber dem Kongostaat und Britisch-Ostafrika von seiten der deutschen Kommissare in den Jahren 1902 bis 1905 ausgeführt worden sind. Bearbeitet . . . von Prof. Dr. L. Ambrohn. *Maps.*

Kamerun—Adamawa. *Deutsches Kolonialblatt* 18 (1907): 1139-1142.

Strümpell.

Aus West-Adamawa (Bericht des Oberleutnants Strümpell). *Map.*

On journeys on the German side of the frontier with Nigeria, south-west of Yola.

Portuguese West Africa—São Thomé.

A ilha de S. Thomé e o trabalho indigena. Lisbon, 1907. Size $9\frac{1}{2} \times 6$, pp. xx. and 100. *Presented by the Lisbon Geographical Society.*

A reprint of papers by various authors on the island and its agricultural development.

South Africa.

Scottish G. Mag. 23 (1907): 617-627.

Milner

Geography and statecraft. By the Right Hon. Viscount Milner. *Portrait.*

The value of geographical knowledge in the sphere of government and administration is illustrated by the case of South Africa

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Cairnes.

Geological Survey of Canada. Moose Mountain district of Southern Alberta. By D. D. Cairnes. Ottawa, 1907. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 56. *Map, Sections, and Illustrations.*

Canada—Alberta.

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Geological Survey of Canada. Report on the Cascade Coal Basin, Alberta. By D. B. Dowling. Ottawa, 1907. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 38. *Illustrations and separate case of Maps. Presented by the Colonial Office.*

Canada—Geology.

Summary report of the Department of Mines, Geological Survey, for the calendar year 1907. Ottawa, 1908. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. viii. and 132. *Map.*

Canada—Mines.

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On the need of a topographical survey of the Dominion of Canada, particularly with reference to the development of the economic resources of the Dominion. By Frank D. Adams. (From the *Journal of the Canadian Mining Institute*, part of vol. 9.) Size $8\frac{1}{2} \times 6$, pp. 14.

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Department of the Interior. Report of the Surveyor-General of Dominion Lands for the year ending June 30, 1906. Ottawa, 1907. Size $10 \times 6\frac{1}{2}$, pp. 330. *Illustrations; Maps in separate cover. Presented by the Surveyor-General.*

Includes a report on the photo-topographical survey of the Rocky mountains, and an account, with map, of the recently discovered Nakimu caves, near Roger's pass (ante, p. 338).

Canada—Yukon Territory.

Brown.

University of Toronto Studies, History, etc. 2 (1907): 195-212.

The evolution of law and government in the Yukon Territory. By John N. Elliott Brown.

- St. Lawrence Basin.** Barrows and Horton.
U. S. Geol. Surv., Water Supply Paper 206 (1907): pp. 98.
 Surface water-supply of Great Lakes and St. Lawrence river drainages, 1906. By H. K. Barrows and A. H. Horton. *Map, Section, and Illustrations.*
- United States.** Williams.
 With the Border ruffians: memories of the Far West, 1852-1868. By R. H. Williams, edited by E. W. Williams. London: J. Murray, 1907. Size 9 x 5½, pp. xviii. and 478. *Illustrations.* Price 12s. net. Presented by the Publisher.
- United States—Hydrology.** Follansbee and others.
U. S. Geol. Surv., Water Supply Paper 208 (1907): pp. 190.
 Surface water-supply of Missouri river drainage, 1906. By Robert Follansbee, R. I. Meeker, and J. E. Stewart. *Map, Section, and Illustration.*
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U. S. Geol. Surv., Water Supply Paper 205 (1907): pp. 124.
 Surface water-supply of Ohio and Lower Eastern Mississippi river drainages, 1906. By M. R. Hall, N. C. Grover, and A. H. Horton. *Map, Section, and Illustration.*
 Similar papers have been issued for a number of other drainage systems.
- United States—Irrigation.** Report Smithsonian I. 1906 (1907): 469-492. Blanchard.
 National reclamation of arid lands. By C. J. Blanchard. *Illustrations.*
- United States—Maryland.** Mathews.
Johns Hopkins University Circular (1907): No. 7, 27-34.
 Anticlinal domes in the Piedmont of Maryland. By Edward B. Mathews. *Sketch-maps.*
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 The counties of Maryland, the time and manner of erection. By Edward B. Mathews. *Map.*
- United States—San Francisco.**
 Report of the sub-committee on statistics to the Chairman and Committee on reconstruction. San Francisco, 1907. Size 9 x 6, pp. 16.
 Discusses the effects of the San Francisco earthquake on various kinds of buildings.
- United States—Waterway.** National G. Mag. 18 (1907): 679-685.
 The deep-water route from Chicago to the Gulf. *Map and Illustrations.*
 On a proposal to construct a deep waterway through the Mississippi valley.
- United States—West.** Thwaites.
 Early Western Travels, 1748-1846. Edited by Dr. R. G. Thwaites. Vol. 25 comprising the series of original paintings by Charles Bodmer, to illustrate Maximilian Prince of Wied's Travels in the Interior of North America, 1832-1834. Cleveland, Ohio: A. H. Clark Co., 1906. Size 21 x 15. *Eight Plates and Map.* Price 62s. 6d.
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- Brazil.** Rev. I. Hist. e G. Brasileiro 68 (1907): Part II., 253-376. Pimentel.
 A Brazil central (Estudos patrios). Pelo Dr. Antonio Martins de Azevedo Pimentel. *Map and Illustrations.*
 A useful summary of our knowledge of a still undeveloped part of Brazil.
- Central America—Climatology.** M. V. E. Leipzig 1906 (1907): 1-96. Mers.
 Beiträge zur Klimatologie und Hydrographie Mittelamerikas. Von Dr. Alfred Mers. *Map and Diagrams.*

Chile—Surveys.

República de Chile. Oficina de Mensura de Tierras. Reglamento interno e instrucciones técnicas. (Size 7 × 5, pp. 110.) Instrucciones para el reconocimiento trigonométrico, destinado a ubicar las triangulaciones i bases jeodésicas. Size 7½ × 5½, pp. 64. Santiago, 1907. *Diagrama*.

South America—Altitudes.**Jahn.**

Tablas barométricas para el cálculo de alturas entre los paralelos 0° y 16° de la América tropical. Por Alfredo Jahn. Caracas, 1907. Size 9 × 6, pp. 48.

South America—Geological History.**Ihering.**

Archäolithen und Archinotis. Gesammelte Beiträge zur Geschichte der neotropischen Region, von Hermann von Ihering. Leipzig: W. Engelmann, 1907. Size 9 × 6, pp. iv. and 350. *Map. Price 6m. Presented by the Publisher.*

South America—Meteorology.**Voss.**

Petermann's *M.*, *Ergänzungsheft* 157 (1907): pp. vi and 60.

Die Niederschlagsverhältnisse von Südamerika. Von Ernst Ludwig Voss. *Maps and Diagram.*

South America—Rivers.**Larrabure i Correa.**

Noticia historico-geográfica de algunos rios de nuestro Oriente, por el Doctor Carlos Larrabure i Correa. Lima, 1907. Size 9½ × 6½, pp. 174. *Map and Illustrations. Presented by the Author.*

Descriptions of the principal rivers of the borderland between Peru, Bolivia, and Brazil, mostly within territory claimed by the two latter.

West Indies—Barbados. Quarterly J. Geol. S. 63 (1907): 318-337.**Harrison.**

The Coral rocks of Barbados. By Prof. John Burchmore Harrison. *Map and Sections.*

West Indies—Jamaica.*J. Geology* 15 (1907): 696-721.**Fuller.**

Notes on the Jamaica earthquake. By Myron L. Fuller. *Sketch-map and Illustrations.*

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New Guinea—Dutch. *Ts. k. Nederlandsch Aard. Genoots.* 24 (1907): 992-1029. **Dissel.**
Reis van Goras langs de Bédidi naar Ginaroe, en over Womérá weer naar Goras. (Vierde voetreis in het bergland van Z. W. Nieuw-Guinea.) Door J. S. A. van Dissel. *Map.*

New Guinea—Dutch.**Hellwig.**

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Verdere exploraties aan de Zuidwestkust van Nieuw-Guinea. Door R. L. A. Hellwig. *Map.*

New Guinea—German. M. a. d. Deutschen Schutzgeb. 20 (1907): 223-231.**Pösch.**

Wanderungen im Gebiete der Kai (Deutsch-Neuguinea). Von Dr. Rudolf Pösch. *Map and Illustrations.*

New Guinea—Historical. B.G. hist. et descriptive, 1907: 47-72.**Hamy.**

Luis Váez de Torres et Diego de Prado y Tovar; explorations de la Nouvelle-Guinée, 1606-1607. Étude géographique et ethnographique par le Dr. E. T. Hamy. *Facsimile Maps and Illustrations.*

Reproduces some hitherto unpublished drawings of natives.

New South Wales. Queensland G.J. 22 (1906-1907): 20-51.**Thomson.**

The Murrumbidgee water conservation and irrigation schemes. By Dr. J. P. Thomson.

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New Zealand. J.R. Colonial I. 39 (1907): 38-56.**Bell.**

The Mineral Wealth of New Zealand. By Dr. J. Mackintosh Bell.

POLAR REGIONS.**Antarctic—Ice.***Z. Gletscherkunde* 2 (1907): 1-21.**Philippi.**

Ueber die Landeis-Beobachtungen der letzten fünf Südpolar-Expeditionen. Von E. Philippi.

- Arctic.** *B. American G.S.* 39 (1907): 607-620. **Mikkelsen.**
 Report of the Mikkelsen-Leffingwell expedition (Prepared by Captain Einar Mikkelsen.) *Map and Diagram.*
 This was given in abstract in the *Journal* for November, 1907 (pp. 517-524, with map and illustrations).

MATHEMATICAL GEOGRAPHY.

- Cartography—Projections.** **Duchesne.**
 Travaux du Séminaire de Géographie de l'Université de Liège, Fascicule 7. L'enseignement des projections cartographiques. Par Charles Duchesne. Liège, 1907. Size 10 × 6½, pp. 34. *Diagrams.*
Longitudes. *T. and P. New Zealand I.* 39 (1906): 49-70. **Klotz.**
 Transpacific longitudes. By Dr Otto Klotz. *Map*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

- Geomorphology.** *B. American G.S.* 39 (1907): 658-666. **Hubbard.**
 Experimental Physiography. By George D. Hubbard. *Illustrations.*
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 Zur Entstehung von Quertälern in Faltengebirgen. Von Dr. Siegfried Passarge. *Diagrams.*
 See March number, p. 339.
Geomorphology—Arid Regions. **Grund.**
Sitzungsber. K.A.W. Wien 115 (1906): 1 Abt., 525-551.
 Die Probleme der Geomorphologie am Rande von Trockengebieten. Von Dr. A. Grund.
Geomorphology—Coastal Plains. *J.G.* 6 (1907): 8-15. **Davis.**
 The place of coastal plains in systematic physiography. By W. M. Davis.
Geomorphology—Mountains. *Petermanns M.* 53 (1907): 245-260. **Frech.**
 Erdbeben und Gebirgsbau. Von Prof. Dr. Fr. Frech. *Map.*
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Glacial Epoch. **Manson.**
 An attempt to explain the evidences of glacial action during the Permian. By Dr. Marsden Manson. (San Francisco, 1907.) Size 9 × 6, pp. 16.
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 Glacial erosion in longitudinal valleys. By Frank Carney. *Map and Illustrations.*
Glaciers. *Z. Gletscherkunde* 2 (1907): 81-103. **Finsterwalder.**
 Die Theorie der Gletscherschwankungen. Von S. Finsterwalder. *Diagrams.*
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 Probleme der Gletscherkunde. Von Hans Hess. *Diagrams.*
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 A proof of Kurowski's rule for determining the height of the Nêvé line on glaciers. By Harry Fielding Reid. *Diagram.*
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 Ueber den Koeffizienten der inneren Reibung des Gletschereises und seine Bedeutung für die Theorien der Gletscherbewegung. Von Boris Weinberg. *Diagrams.*
Limnology. **Wedderburn.**
 An experimental investigation of the temperature changes occurring in fresh-water lochs. By E. M. Wedderburn. (From the *Proceedings of the Royal Society of Edinburgh*, vol. 33, part i., No. 1.) Edinburgh, 1907. Size 19 × 7, pp. 2-20. *Diagrams and Illustration.*
Natural Regions. *G. Teacher* 4 (1907): 123-128. **Roxby.**
 What is a "natural region"? By Percy M. Roxby.
Oceanography—Depths. *Queensland G.J.* 22 (1906-07): 1-19. **Eaton.**
 Concerning ocean depths. By Captain William Eaton.

- Oceanography—Life.** *B.I. Océanogr. Monaco* 108 (1907): pp. 18. **Oxner.**
 Quelques observations biologiques et expériences sur "la Faune des bords de
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- Rivers.** *Nature* 77 (1907): 100-102. **Buchanan and Lomas.**
 The windings of rivers. Letters from J. Y. Buchanan and J. Lomas. *Diagrams.*
 Elicited by the communication of Sir O. Lodge in a previous issue of *Nature* (*Journal*,
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- Seismology.** *Sitzungsber. K.A.W. Wien* 115 (1906): *Abt. IIa.*, 941-982. **Benndorf.**
 Ueber die Art der Fortpflanzung der Erdbebenwellen im Erdinnern (II. Mitteilung).
 Von Dr. H. Benndorf. *Diagrams. Also separate copy.*
- Snow—Morphology.** *Z. Gletscherkunde* 2 (1907): 103-112. **Tschirwinsky.**
 Schneedünen und Schneeabarchane in ihrer Beziehung zu isolischen Schneeeblage-
 rungen in allgemeinen. Von P. N. Tschirwinsky. *Illustrations.*
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 A study of nieves penitentes in the Himalaya. By Dr. William Hunter Workman.
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- Anthropogeography.** *J.G.* 6 (1907): 16-20. **Emerson.**
 Flood-plains in their relation to life. By Philip Emerson.
- Anthropogeography.** *B.S.G. Italiana* 9 (1908): 103-121. **Porena.**
 L'Antropogeografia nelle sue origini e ne' suoi progressi. Relazione . . . dal prof.
 Filippo Porena.
- Commercial—Gold.** *J.S. Arts* 55 (1907): 1003-1014, 1022-1032, 1037-1047. **Gregory.**
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 and Sections.*
- Commercial—Minerals.** *P.R.I.* 18 (1907): 305-321. **Gregory.**
 Ore deposits and their distribution in depth. By Prof. J. W. Gregory.
- Commercial—Ports.** **Corthell.**
 Permanent International Association of Navigation Congresses. Results of investi-
 gation into the cost of ports and of their operation. By Elmer L. Corthell. Brussels,
 1907. Size 9½ x 6, pp. 58.
- History.** **Helmolt**
 Weltgeschichte . . . herausgegeben von Hans F. Helmolt. Neunter Band:
 Nachträge, Quellenkunde; Generalregister. Leipzig, etc., Bibliographisches
 Institut, 1907. Size 10 x 7, pp. viii, und 678. *Maps and Illustrations. Price 9s.*

GENERAL

- Educational—Meteorology.** *Scottish G. Mag.* 23 (1907): 627-648. **Newbigin.**
 The study of the weather as a branch of nature knowledge. By Marion I. New-
 bigin. *Charts and Diagrams*
- Geography.** *J.G.* 6 (1907): 49-53. **Davis.**
 Hettner's conception of geography. By W. M. Davis.
 Analysis of Dr. Hettner's article in the *Geographische Zeitschrift* for 1905, in which
 greater emphasis is laid on Regional Geography than in Prof. Davis's own writings.
- Geography.** *Scottish G. Mag.* 23 (1907): 561-568. **Eckert.**
 The new fields of geography, especially commercial geography. By Prof. Dr.
 Max Eckert.
 Paper read at the Leicester meeting of the British Association.
- Geography.** **Tiessen.**
 Beobachtende Geographie und Länderkunde in ihrer neueren Entwicklung,
 nebst einem Wort zum fünfundzwanzigjährigen Bestehen der Zentralkommission
 für wissenschaftliche Landeskunde von Deutschland. Von Dr. E. Tiessen.
 (Sonderabdruck aus: Verhandlungen des xvi. Deutschen Geographentages zu
 Nürnberg, 1907.) Berlin, 1907. Size 9½ x 6½, pp. 51-65.

German Colonies.**Reimer.**

Dietrich Reimer's Mitteilungen für Ansiedler, &c. Heft 3: September, 1907.
 Berlin: D. Reimer. Size $8\frac{1}{2} \times 6$, pp. 118-150. *Illustrations.*

This new publication contains articles on subjects of special interest to settlers, with bibliographical notes. The present number pays special attention to rubber.

Literary Geography.*Alpine J.* 23 (1907): 625-627.**Freshfield.**

The Mountains of Dante. II. By Douglas Freshfield. *Illustration.*

Supplementary to a paper in the tenth volume of the same journal.

Space and Time.**Ratzel.**

Raum und Zeit in Geographie und Geologie. Naturphilosophische Betrachtungen von Dr. Friedrich Ratzel. Herausgegeben von Dr. Paul Barth. Leipzig: J. A. Barth, 1907. Size $9 \times 5\frac{1}{2}$, pp. viii. and 178. *Price 8s. 9d.*

NEW MAPS.

By E. A. REEVES, *Map Curator, R.G.S.*

EUROPE.**Austria.****K. Akademie der Wissenschaften, Vienna.**

Historischer Atlas der österreichischen Alpenländer Herausgegeben von Kais. Akademie der Wissenschaften in Wien. I. Abteilung: Die Landgerichtskarte. I. Lieferung: Salzburg, Oberösterreich, Steiermark. Vienna: Adolf Holzhausen, 1906. *Price 12 kr. each part.*

This is the first part of an historical atlas of the Alpine provinces of Austria, which was originally planned by the late Dr. Eduard Richter, and is now being published by the Imperial Academy of Sciences in Vienna. The maps, of which there are eleven and an index in this part, are on the scale of 1:200,000, and as regards topographical features, are based upon the sheets of the Austrian staff map on the same scale. Forty-nine pages of explanatory text are given in a separate cover. A review of this atlas appeared in the *Geographical Journal* for June, 1907.

Danube.**Cvijic.**

Entwicklungsgeschichtliche Karte des Eisernen Tores. Von Prof. Dr. J. Cvijic. Scale 1:200,000 or 1 inch to 3.2 stat. miles. Geologische Skizze zur Entwicklungsgeschichte des Eisernen Tores. Von Prof. Dr. J. Cvijic. Scale 1:300,000 or 1 inch to 4.7 stat. miles. *Petermanns Mitteilungen*, Ergänzungsheft No. 160. Gotha: Justus Perthes, 1908. *Presented by the Publisher.*

England and Wales.**Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from March 1 to 31, 1908.

2 miles to 1 inch:—

Large-sheet series, printed in colours, folded in cover or flat in sheets, 20, 21, 22, 23, 26, 27, 31, 35. Coloured on the layer system, 18, 19, 24, 25, 29, 30, 34, 39, 40. *Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.*

1-inch (third edition):—

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Large-sheet series, printed in colours, folded in cover or flat in sheets, 27, 28, 32, 33, 37, 106, 123, 133. *Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.*

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14 s.e., 23 n.e., 24 s.e., 25 s.w., s.e., 26 n.w., 34 n.e., 35 s.w., 57 n.e., s.e., 58 n.w., s.w. (58 s.e. and 58a s.w.), 66 n.e., s.e., 67 n.w. (68 n.e. and 68a n.w.), 81 n.e., **Lancashire** (First Revision of 1891 Survey), 102 s.e., 108 n.e., 114 n.w., 115 n.e., s.w. **Lincolnshire** (First Revision), 10 n.e., 11 n.w., 12 n.w., n.e., 70 n.e. **Norfolk**, 31 s.e., 43 n.e., s.e., 52 s.w., 55 n.e., s.e., 56 s.w., 63 n.e., s.w., s.e., 64 s.w., 65 n.w., 67 n.e., s.e., 68 n.w., s.w., 74 n.e., 79 n.e., s.e., 80 n.w., s.w., s.e., 81 s.w., 91 n.w., s.w., 91a n.w. **Pembrokeshire** (First Revision), (2a s.e. and 5 n.e.), 5 s.e., 8 s.w., s.e., 9 s.w., 10 n.e., s.e., 11 n.w., s.w., s.e., 13 s.w., 15 n.w., n.e., s.w., 16 n.w., n.e., s.w., s.e., 17 n.w., n.e., s.w., s.e., 18 s.w., s.e., 19 n.e., 22 n.w., 23 n.w., s.w., s.e., 24 s.e., 25 s.w., 28 n.w., n.e., s.w., 29 s.w., s.e., 30 s.w., 34 n.e., s.e., 35 n.w., s.w., 40 n.e., s.e., 41 n.w., n.e., s.w., 43 n.e., 44 n.w. **Yorkshire** (First Revision of 1891 Survey), 246 s.e., 247 n.e., 248 s.w., 249 n.w., 259 s.w., 260 n.e., 266 s.e. 1s. each.

25-inch—County Maps:—

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(E. Stanford, London Agent)

England and Wales.

Geological Survey.

1-inch map:—

New series, printed in colours, Drift edition. Sheets, 125, Derby; 295, Taunton and Bridgwater; special map of Oxford. Price 1s. 6d. each.

6-inch maps—Uncoloured.

Glamorgan, 20 n.w., 29 s.w.; Monmouthshire, 22 n.w., 27 s.w., 28 n.w. 1s. 6d. each.

E. Stanford, London Agent.

England—London.

Hollar.

London, Westminster, and Southwark, drawn and engraved by Wenceslaus Hollar. Published at Antwerp in 1647. Sheets 1—III and VII. London: The London Topographical Society, 1907.

The first three sheets of this beautifully executed facsimile of Hollar's bird's-eye view of London were noticed in the *Geographical Journal* for June, 1907, and those now published complete the work. The London Topographical Society deserves the thanks of all interested in the history of the development of London for the excellent facsimiles of old plans now in course of publication.

Europe—Central.

Ravenstein and Liebenow.

Ravenstein-Liebenow's Special-Rad- und Automobilkarte von Mittel-Europa. Scale 1:300,000 or 1 inch to 4.7 stat. miles. Sheets: 1, Ringkjöbing; 2, Fredericia; 3, Roskilde; 4, Kjöbenhavn; 5, Simrishamn; 12, Korsör; 13, Falsterbo; 14, Bornholm; 107, Krakau; 121, Leutachau. Frankfurt-a.-M.: Ludwig Ravenstein, [1908]

Germany.

K. Preussische Landesaufnahme.

Karte der Deutschen Reiches. Herausgegeben von der Kartogr. Abteilung der Kgl. Preuss. Landesaufnahme. Scale 1:100,000 or 1 inch to 1.6 stat. mile. Sheets: (black hills) 363, Eisleben; 387, Sondershausen; 388, Querfurt; (brown hills) 298, Meeseritz; 316, Belzig; 346, Grünberg. Berlin: K. Preussische Landesaufnahme, 1906–07. Price 1.50m. each sheet.

ASIA.

Asia Minor.

Kiepert.

Karte von Kleinasien. Bearbeitet von Dr. Richard Kiepert. Scale 1:400,000 or 1 inch to 6.3 stat. miles. Sheet A-IV., Sinob. Berlin: Dietrich Reimer (Ernst Vohsen, [1908]). Price 6m. each sheet.

AFRICA.

Africa—East.

Jurisch and Moisel.

Die deutsch-englische Grenze zwischen dem 30. Längengrad und dem Djipe-See, nach den Aufnahmen der deutsch-englischen Grenzexpedition unter Leitung von Hauptmann Schlobach und Colonel Delmé-Radcliffe sowie des Colonel G. E. Smith. Bearbeitet nach den Original Messtischblättern von C. Jurisch unter Leitung von M. Moisel. Scale 1:1,000,000 or 1 inch to 15 stat. miles.—Triangulationsnetz der Hermann'schen Kiwu- und der Schlobach'schen Uganda-Grenzexpedition.—Triangulationsnetz der Schlobach'schen Grenzexpedition zwischen dem Victoria-See und Zanzibar. Scale 1:927,500 or 1 inch to 14.6 stat. miles. *Mitteilungen aus den deutschen Schutzgebieten*, Band xx. 1907, Karten 5, 6 u. 7. Presented by Dietrich Reimer, Berlin.

Two triangulation charts and a topographical sheet, showing the boundary between British and German East Africa according to the surveys of the German Commissioners. The corresponding triangulation and surveys of the British Commissioners, under Colonel Delmé-Radcliffe and Colonel G. E. Smith, were published some time ago, and reductions have appeared in the *Geographical Journal*. The British surveys have been utilized, as well as the German, in the compilation of the topographical map, which extends from Kilimanjaro, across Victoria Nyanza, to about 29° 40' E. long.

German East Africa.

Wehlmann and Moisel.

Das Ukinga-Gebirge auf Grundlage der Triangulation und der Messtischaufnahme Dr. Kohlschütter's. Neu gezeichnet von H. Wehlmann unter Leitung von M. Moisel. Scale 1:100,000 or 1 inch to 1.6 stat. miles. *Mitteilungen aus den deutschen Schutzgebieten*, Band xxi, 1908, Karte 1. Berlin: E. S. Mittler & Sohn, 1908. Presented by Herr Dietrich Reimer, Berlin.

An excellent map of the Livingstone mountains and country adjacent to the north-east of Lake Nyasa, from the triangulation and plane-table survey of Dr. Kohlschütter, supplemented by route surveys of various travellers.

Gold Coast.

Guggisberg.

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1:125,000 or 1 inch to 1.9 stat. miles. Sheets: 72-L-I., Abetife; 72-Q-L., Dunkwa. Edinburgh and London: W. & A. K. Johnston, 1908. Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.

Two additional sheets of the survey of the Gold Coast, under the direction of Major F. G. Guggisberg, R.E. There is room for improvement in the colouring of the sheets, and the hill shading is not altogether satisfactory. Approximate contour lines are shown in green on sheet 72-L-I., as well as hill shading, but the figures on these might with advantage have been written all one way up, since, as they are, the sheet has to be turned round to read them in many places.

Kamerun.

Glauning.

Provisorische Karte von Teilen der Bezirke Ossidinge, Bamenda und Dechaug. Konstruiert und gezeichnet auf Grundlage der Aufnahmen des Hauptmann Glauning und mit Benutzung unveröffentlichter Aufnahmen. Scale 1:500,000 or 1 inch to 7.9 stat. miles. *Mitteilungen aus den deutschen Schutzgebieten*, Band xx., 1907, Karte 10. Berlin: E. S. Mittler & Sohn, 1907. Presented by Herr Dietrich Reimer, Berlin.

Togo.

Sprigade.

Karte von Togo. Bearbeitet von P. Sprigade. Scale 1:200,000 or 1 inch to 3.2 stat. miles. Sheets: A1, Sansane-Mangu; B1, Jéndi; B2, Bassari. Berlin: Dietrich Reimer (Ernst Vohsen), 1907. Presented by the Publisher.

AMERICA.

Canada.

Dept. of the Interior, Ottawa.

Sectional map of Canada. Scale 1:190,080 or 1 inch to 3 stat. miles. Sheets: 164, Morley, revised to December 25, 1907; 168, Elbow, revised to January 27, 1908; 215, Red Deer, revised to January 28, 1908; 216, Sullivan Lake, revised to November 27, 1907; 265, Peace Hills, revised to January 9, 1908; 267, Battleford, revised to January 2, 1908; 366, Saddle Lake, revised to January 22, 1908. Ottawa: Department of the Interior, Topographical Surveys Branch, 1907-08. Presented by the Department of the Interior, Ottawa.

Chile.

Oficina de Limites, Santiago.

Comision Chilena de Limites. Scale 1:250,000 or 1 inch to 2.9 stat. miles. No. V.—May, 1908.]

Sheets: Autofogusta (lat. 23° to 24° S., and lat. 24° to 25° S.). Santiago: Oficina de Limites, [1908]. *Presented by the Oficina de Limites, Santiago.*

Venezuela.

'Petermanns Geogr. Mitteilungen.'

Übersicht der neuen Landesaufnahme im nördlichen Venezuela. Scale 1:1,500,000 or 1 inch to 23·7 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1908, Tafel 7. Gotha: Justus Perthes, 1908. *Presented by the Publisher.*

AUSTRALASIA.**Australasia.**

Sydow and Habenicht.

Sydow-Habenicht: Methodischer Wand-Atlas. Nr. 1, Australien und Polynesien. Oro-hydrographische Schul-Wandkarte nach E. v. Sydows Plan bearbeitet von H. Habenicht. Vierte Auflage. Scale 1:6,000,000 or 1 inch to 94·7 stat. miles. 12 sheets. Gotha: Justus Perthes, [1908]. *Presented by Herr Herrman Habenicht.*

Bismarck Archipelago.

Wernicke.

Der nördliche Teil der Gazelle-Halbinsel. Unter Zugrundelegung der Aufnahmen von Wilhelm Wernicke u. S. M. S. Möwe, gezeichnet von F. Bischoff unter Leitung von M. Moisel. Scale 1:100,000 or 1 inch to 1·6 stat. mile. 2 sheets. *Mitteilungen aus den deutschen Schutzgebieten*, Band xxi., 1908, Karten 2, a und b. Berlin: E. S. Mittler & Sohn, 1908. *Presented by Herr Dietrich Reimer, Berlin.*

A large-scale map of the northern extremity of Neu Pommern, in the Bismarck archipelago, showing little more than the coast-line, with mission stations, native reserves, private lands, etc. Inset plans on enlarged scales are given of Herbertstrolch and Rabasil-Bucht.

German New Guinea.

Moisel and Pösch.

Der Sattelberg und Umgebung (Kaiser-Wilhelmsland). Bearbeitet von M. Moisel mit Benutzung neuer Aufnahmen Dr. Rudolf Pösch's Januar-Februar 1906. Scale 1:100,000 or 1 inch to 1·6 stat. mile. *Mitteilungen aus den deutschen Schutzgebieten*, Band xx., 1907, Karte 8. Berlin: E. S. Mittler & Sohn, 1907. *Presented by Herr Dietrich Reimer, Berlin.*

German New Guinea.

Rheinischen Mission, Kaiser-Wilhelmsland.

Die Umgebung des Hausemann-Berges (Kaiser-Wilhelmsland) nach den Vermessungen der Rheinischen Mission. Scale 1:20,000 or 3·2 inches to 1 stat. mile. *Mitteilungen aus den deutschen Schutzgebieten*, Band xx., 1907, Karte 9. Berlin: E. S. Mittler & Sohn, 1907. *Presented by Herr Dietrich Reimer, Berlin.*

World.

Harmaworth.

Harmaworth Atlas and Gazetteer. Supplementary Part containing Title-page, Contents, etc. London: The Amalgamated Press, Ltd. 1908. *Price 7d.*

To be reviewed.

World.

Kiepert.

Formae Orbis Antiqui. 36 Karten im Format von 52:64 cm. mit Kritischem Text und Quellenangabe zu jeder Karte. No. x. Coloniae Phoenicum et Graecorum. No. xvi. Graecia cum Macedonia et Epito tempore foederum Aetolici et Achaici anno 270 a. Chr. n. Bearbeitet und herausgegeben von Richard Kiepert. Berlin: Dietrich Reimer (Ernst Vohsen), 1908. *Price 3m. each sheet.*

World.

Society for the Propagation of the Gospel.

The Churchman's Missionary Atlas. Westminster: The Society for the Propagation of the Gospel in Foreign Parts, 1907. *Price 4s. net. Presented by the Publishers.*

A quarto atlas, containing ninety-eight roughly drawn maps, printed in colour, and one hundred and one pages of letterpress, dealing with all missions connected with the Anglican Church throughout the world. The mission stations of the Society for the Propagation of the Gospel receive special attention. The atlas is based upon that published by the same Society in 1903. The maps and printed information have been submitted to the bishops and other representatives of the various dioceses for correction, so that the information given should be as far as possible reliable.

CHARTS.**Admiralty Charts.**

Hydrographic Department, Admiralty.

Charts and Plans published by the Hydrographic Department, Admiralty, during February, 1908. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
1836 m = 12·0		Scotland, west coast:—Tobermory harbour. 2s.
3670 m = 0·28		Mediterranean:—Malta channel. 3s.
3646 m = 6·0		China, south coast, Canton river:—Whampoa to Canton, sheet I. 3s.
3647 m = 6·0		China, south coast, Canton river:—Whampoa to Canton, sheet II. 3s.
3605 m = 1·1		China, south coast:—Hongkong to Mirs bay. 3s.
2543 m = 0·25		New Zealand:—Maunganui bluff to Manukau harbour, and Tutukaka harbour to Mayor island, including Hauraki gulf. 3s.

New Plans and Plans added.

1301 m = 1·4		Plans on the coast of Chile. New Plan:—Mojillones del Sur Bay. 3s.
895 m =	(11) (10) (13)	Eastern archipelago:—Plans of anchorages in Bali, Lombok, Sumbawa, and adjacent islands; New Plans:—Kombal bay, Ampenan road, Labuan Tring bay. 2s.
3002 m = 1·95		China, east coast, Bias bay. Plan added.—Samun road. 2s.

Charts Cancelled.

No.		Cancelled by	No.
1836	Scotland, west coast:—Tobermory harbour.	New Chart.	
1742	Canton river, sheet IV.:—Plan of Whampoa anchorage on this sheet.	Tobermory harbour	1836
1964	China, south coast:—Mirs bay.	New chart.	
2543	New Zealand:—The west coast from Maunganui bluff to Manukau harbour; the east coast from Tutukaka harbour to Mayor island, including Hauraki gulf.	Whampoa to Canton, sheet I	3646
		Hongkong to Mirs bay	3605
		New chart.	
		Maunganui bluff to Manukau harbour and Tutukaka harbour to Mayor island, including Hauraki gulf	2543

Charts that have received Important Corrections.

No. 1698, England, south coast:—Dover bay. 2447, England, south coast:—The Lizard and adjacent rocks. 125, Belgium:—Ostende roads. 3377, Norway:—Ure to Brettesnes. 2483, Atlantic and Indian oceans. 2060a, North Atlantic ocean, eastern portion. 2202a, South Atlantic ocean, eastern portion. 2202b, South Atlantic ocean, western portion. 2564, United States, east coast:—Delaware river, sheet II. 2831, Gulf of Mexico:—Galveston bay. 192, Gulf of Mexico:—Galveston entrance. 643, Africa, south coast.—Port Natal. 2908, Africa, south coast:—Port Natal entrance. 2762, Indian ocean islands:—Comoro islands, with adjacent coast of Madagascar. 3028, Cochin China:—Kam ranh bay. (J. D. Potter, Agent.)

Indian Ocean and Red Sea.

Meteorological Office.

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, April, 1908. London: Meteorological Office, 1908. Price 6d. each. Presented by the Meteorological Office.

North Atlantic and Mediterranean.

Meteorological Office.

Monthly meteorological charts of the North Atlantic and Mediterranean, April, 1908. London: Meteorological Office, 1908. Price 6d. each. Presented by the Meteorological Office.

North Pacific.

U.S. Hydrographic Office.

Pilot chart of the North Pacific Ocean, April, 1908. Washington: U.S. Hydrographic Office, 1908. Presented by the U.S. Hydrographic Office.

PHOTOGRAPHS.

Asiatic Turkey and North Africa.

Thompson.

112 photographs of Asiatic Turkey and North Africa, taken by Prof. R. Campbell Thompson, M.A. Presented by Prof. R. Campbell Thompson.

Although small, many of these photographs are of considerable geographical and

archaeological interest, as may be gathered from the titles. Prof. Campbell Thompson has travelled in North Africa, the Sudan, Syria, Mesopotamia, and Persia, and is a recognized authority on archaeological matters connected with those parts.

Asiatic Turkey.—(1) My caravan from Aleppo; (2) The Euphrates below Rakka; (3) A ferry over the Khabur at Es-Sawar; (4) The town of Der-es-zor; (5) Khan in Der-es-zor; (6) Crossing the Euphrates at Der-es-zor; (7) On the top of the mound of Shekh Hamad; (8) Sick horse at Addan; (9) The mound of Shekh Hamad; (10) Yezidi women carrying water-skins in the Sinjar hills; (11) Sinjar hills in the distance; (12) Mixed Yezidi and Moslem children in the Sinjar hills; (13-16) Street in Mosul; (17) Square in Mosul; (18) M. Nimroud Rassam and family, British Consular Agent at Mosul; (19) The mound of Kuyunjik, Nineveh; (20) The Khosr and eastern slope of mound of Nineveh; (21 and 22) Quay on east side of mound of Nineveh; (23 and 24) The mill of Armushiyeh on the banks of the Khosr; (25) Eastern slopes of the mound of Nineveh; (26) Sister mound to Kuyunjik, Nebi Yunus, where the prophet Jonah is supposed to be buried; (27) Watcher's hut on top of mound of Nineveh; (28) East wall of Nineveh, with ancient ford across the river Khosr; (29) Arbela; (30) The bridge at Altun Kupri; (31 and 32) Stele and inscription of Sennacherib, behind Jebel Judi, one of the traditional strandings of the Ark; (33) Midday halt after leaving the German excavations at the mound of Kalah Sherghat; (34) The "Great Wheel" at Tekrit; (35) The Tigris, with Samarra's golden dome in the distance; (36 and 37) The Tigris at Baghdad; (38) Leaving Baghdad; (39) Feleja; (40) Midday halt, first station from Baghdad; (41) Hit; (42) One of the island villages on the Euphrates between Anah and Feleja; (43 and 44) Crossing Syrian desert.

Egyptian Sudan.—(1) Port Sudan; (2) Hadendowas buying in Suakin; (3) Houses, Suakin; (4) Hadendowas between the mountains of Herano and Odeano; (5) Fuzzy-wuzzy nursery; (6) Gumadribab; (7) Fuzzy-wuzzies loading camels; (8) Fuzzy-wuzzies filling water-skin; (9) Coming into Gebet mines; (10) Ancient houses at Gebet mines; (11) Fuzzy-wuzzy at Gebet; (12) Ancient water-pool on the Gebet mines; (13) Modern workings, Gebet mines; (14) Ancient quartz crusher, Gebet mines; (15) View over Gebet mines; (16) Ancient houses, Gebet mines; (17) Fuzzy-wuzzy and camels on the way to Mohammed Gul; (18 and 19) Village of Mohammed Gul.

Sinai Peninsula.—(1) Meeting Hewelat Arabs not far from Suez; (2) Halt at Wadi el Hatah; (3 and 4) Taibt el Wadi; (5) Jebel el Tih; (6) Halt at Wadi Werdan; (7) Wadi Gharandel; (8) Wadi Goweisab; (9) Jebel el Tih from Wadi Shebekah; (10) Wadi el Hamr; (11) Wadi el Hamr, looking north-north-east from the Wadi; (12) Sarbut el Jemel; (13) Jebel Wutah from the Debbet er Ramleh; (14) Crossing the Debbet er Ramleh; (15) Wadi Sig; (16 and 17) Hill on the way to Serabut el Khadem; (18) Looking down from the Egyptian temple at Serabut el Khadem; (19) Goats, camels, and donkeys, Wadi Bark; (20) Wadi Umm Ajraf; (21) Entrance to Wadi Maghara; (22) Palms in Wadi Feiran; (23) Ruined monastery, Bel-el Feiraun; (24) Looking up Wadi Feiran; (25) Wadi Feiran; (26) Wadi Sobaf; (27) Jebel Serbal in distance; (28) S'beuh, the hunter, spying for ibex; (29) Pharaoh's bath on the Gulf of Suez.

Tripoli.—(1) Water-wheel near Zanzur, Palms at Girgesab; (2) Mesawud, our zaptieh; (3) Midday halt, women putting up tent; (4) Meeting Arab caravan on the way to Wadi el Ethel; (5) Halt in Wadi el Ethel; (6) Turkish fort at Ifrin; (7) Courtyard inside Turkish fort at Ifrin; (8) The town of Ifrin, from the fort; (9) Artillery barracks, Ifrin; (10) Dance at circumcision festival, Ifrin; (11) En route from Ifrin to Gharian; (12) Market day in Gharian; (13) Volcanic cone of Tekut; (14) Entrance to one of the cave dwellings in Gharian; (15) Roman ruins, and Senam, on the way to Tarhuna; (16) Roman oil-press; (17) The village of Tarhuna; (18) Roman ruins at Lebda; (19) Roman tomb, on the way to Lebda.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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THE OLD KINGDOM OF KONGO.*

By Rev. THOMAS LEWIS.

MORE than four hundred years have elapsed since the early Portuguese explorers sailed into the strong current of the Congo river, whose muddy waters are clearly distinguishable 50, and sometimes 100 miles out at sea. One can imagine the excitement on board the vessels as they turned Shark point and selected a well-sheltered and quiet bay where they could land and erect one of the "padrões" which marked the discoveries of Diogo Cão and his companions. They would naturally look across the mouth of the river and estimate the distance of Banana point, then no doubt a barren strip of sand with no human habitation and no trading establishment to represent the trade and commerce of Europe.

Some time would be occupied with local observations and parleying with the natives, and then this mysterious "Rio Poderoso" would assert its enchanting powers over them and charm them to explore the many islands that stud the river for 50 miles from its mouth. Then the "Fetich" rock would allure them still further and bring them into the narrower and more picturesque part, with high hills covered with grass and rock on either side. Having passed the site of the Congo State capital (Boma), they found the current greatly increased in strength, and it must have taken many days to reach Noki, the principal port on the Portuguese side. Another bend of the river and the sailors are being rudely shaken by the numerous whirlpools of "Hell's Cauldron," and it requires no imagination to believe that it was they who named it the "Inferno." The water here forces itself through a narrow passage, only about half a mile in width, at the rate of 10 or 11 knots an hour, and it is almost a miracle that they were able to

* Read at the Royal Geographical Society, February 24, 1908. Map, p. 700.

get their vessels through at all. Matadi is only 2 miles higher up where the river widens again, and after turning around another point our navigators are within sight of the Yalala falls. These falls or rapids mark the narrowest point on the Congo river, and the ships must have gone right close to them, where the rush of water is tremendous. These daring men must have kept close to the right on the south bank, and entered into the Mpozo river, which falls into the Congo under the shadow of a high and precipitous rocky cliff—perhaps the finest piece of rock-river scenery to be found in the whole of Congo. Here the little fleet found a hospitable shelter in a quiet pool of water.

We know that they visited this spot, for they went ashore and carved into the hard rock an inscription showing the Portuguese arms and a representation of one of Diogo Cão's stone pillars; then follows the legend, "HERE ARRIVED THE SHIPS OF KING DOM JOAM II. OF PORTUGAL," with the names of Diogo Cão and several of his companions.

I leave all remarks on the form and contents of this most interesting and historic inscription to Mr. Heawood, the Society's librarian, to whom the photograph was submitted and to whom I am indebted for the translation.* It is a very remarkable fact that for over 400 years this Mpozo rock has been allowed to keep its secret, and then it was only accidentally discovered by a Mr. Domenjos, a missionary stationed at Matadi, when out on a photographic ramble. Mr. Domenjos died shortly afterwards. The photograph reproduced here was taken by an old friend, Mr. Pettersson, of the Swedish Missionary Society, and given to me by my colleague, Mr. Lawson Forfeitt, who has spent many years at Matadi.

A copy of this photograph has been in my possession for over eight

* The principal part of the inscription, immediately to the right of the royal arms and cross, may be read thus: "Aqy chegaram os navios do estratay (?) do Rey Dom Joam ho segº de Portugal: Dº Caaº: Pº Ans Pº Dacosta." ("Hither arrived the ships of the [fleet?] of King Dom Joam the Second of Portugal: Diogo ('ho: Pedro Anes Pedro da Costa'") More to the right appear other names, mostly in a contracted form, among which the following may be made out: Alvaro Pirez, Pero Escolar, João de Santiago, João Alves, Diogo Pinero (or Pinheiro?), Gonzalo Alvares, Antam. Further names, with crosses and other symbols, occur on a neighbouring portion of the rock, but are not included in the photograph here reproduced. They are shown, however, in Dr Frobenius' recent work. 'Im Schatten des Kongo-Staates' (pp. 6, 7), of which a review appeared in the March number of the *Journal*. The main inscription is given also, though far from distinctly, in the same work, but with a mere passing reference to it in the letterpress. Of the above companions of Cão, João de Santiago and João Alves are stated by Barros (Dec. I., book iii., chap. iv.) to have sailed in the subsequent voyage of Barthomeu Dias, while a Gonzalo Alvares was, according to the same authority (Dec. I., book iv., chap. iii.), master of the *S. Gabriel* in Vasco da Gama's first voyage, in which Pero Escolar also took part as pilot on board the *Berrio* (*Ibid.*, chap. ii.). Mr. Ravenstein points out that a Pedro Anes was pilot in 1503 (Souza Viterbo: 'Trabalhos nauticos dos Portugueses,' vol. 1, p. 39), while a Pero Annes was in Malacca in 1510. Also that a friar, by name Antonio, was left behind in S. Salvador in 1491.



THE D'OGO CAÔ INSCRIPTION AT THE MOUTH OF THE RIVER MPOZO.

years, and until a few months ago I had no suspicion that the existence of the inscription was not a matter of common knowledge. One thing is certain, the great explorers of the Dark Continent have not yet brought everything into light, and the "small fry" have something still left for them to do.

When Diogo Cão, in the year 1482, discovered the Congo river, he also discovered, through the natives of the district, the great and important kingdom of Kongo. He despatched some negro messengers to the Mani Congo (Lord of the Land), who ruled his people with great pomp and ceremony at Ambassa, situated about 150 miles inland at the centre of the kingdom. This place is identical with the "Ekongo" of the modern native, and San Salvador of the Portuguese. These men returned to the navigator with wonderful tales of the great king and his court at the capital, which led to a number of Portuguese being sent out to the newly discovered country to engage in trade with the natives. It was the wise policy of King João II., when new discoveries were made, "to leave some trustworthy Portuguese among the natives to cultivate friendly relations with them, and to push on into the interior under their guidance, so as to collect information of the people and the country of those parts. With this design the king put in action the unceasing desire and zeal which he had for the propagation of the Christian religion, and gave preference to those missionaries who had mathematical knowledge." These worthy aims and noble ideals of the illustrious prince did not long occupy the minds of the merchants and missionaries who settled at the capital, and very soon we find them busily engaged in the more congenial and lucrative business of the slave trade. It is true that the Capuchin monks professed to have converted the king and his people to Christianity, and they built several churches; but there is no doubt about their full share in the "trade." There are many townships in the present day bearing the name of Kinganga (i.e. town of the priests), and the inhabitants consider themselves inherited property of the Catholic priests. In those days the slave trade was looked upon as a most respectable branch of commerce. The slave gangs on their way to the coast were accompanied by one or more priests acting as chaplains, dispensing the consolations of the Church to the wretches who all day long groaned under the lashes of the driver's whip. The routes can be traced still by the names of villages, such as "Vunda" (resting-place), where they rested at noon, and "Vemadia" (Ave Maria), where they slept at night.

ANCIENT CIVILIZATION.

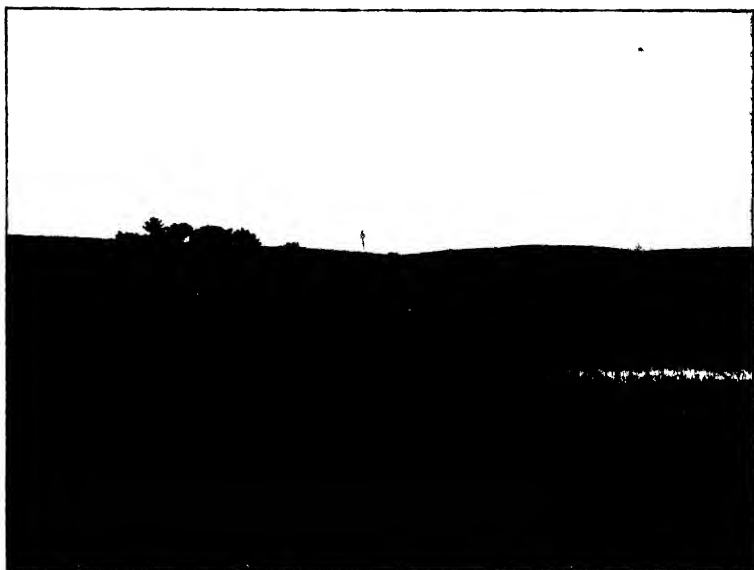
The ancient civilization at San Salvador was due entirely to the slave trade and the Portuguese. Slaves waiting to be sent away to the coast were employed quarrying stones, and building palaces, churches,

and a convent, as well as the massive city walls, one encircling the king's palace and houses of his courtiers, another the European quarters on the southern end of the plateau, while a third enclosed the convent and the principal church from which the place derived its name. The ruins of the church stand at the present time. The kings of Kongo have always been buried in and around this church. Altogether some ten or eleven churches were built on the hill of San Salvador. One was built in honour of the miraculous appearance of the Virgin on horseback to give a remarkable victory over the Yakkas, who were attacking the city. The church was called "Our Lady of Triumph," and we are told by Carli that "it was made of mud, but whitewashed." "Our Lady" must have taken offence at the "mud" or "whitewash," for a year or so afterwards the Yakkas returned to the attack, and she allowed them to raze the city, churches and all, to the ground, and the king and people fled for their lives.

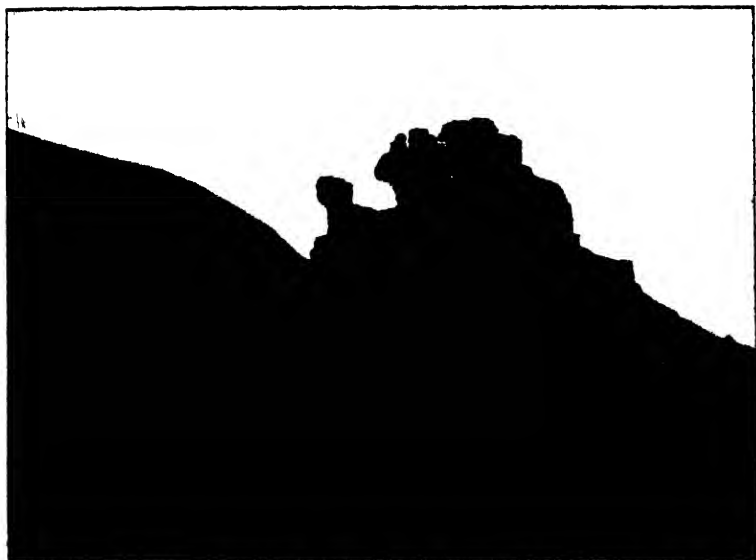
The old kingdom of Kongo was divided into six provinces, of which Mbamba was the richest; the others being Sonyo, Sundi, Mpangu, Mbata, and Mpemba. The princes of these provinces waged incessant war on one another, for each family claimed equal rights to the throne of Kongo, which they were supposed to occupy in rotation. The presence of the Portuguese at the capital strengthened the position of the neighbouring clans of Mpemba, Mbata, and Mpangu, and during the past hundred years most, if not all of the kings of Kongo have belonged to these three families. Mbamba still keeps up a sort of an alliance with Kongo, but Sonyo and Sundi have long ceased to acknowledge any allegiance to the old kingdom.

The Sundi people are now known as the Bakongo, who still inhabit the cataract region.

Sonyo is no doubt a corruption of the Portuguese San Antonio, the name given to the place where the early missionaries settled on the south bank at the mouth of the river. Owing to its position on the coast and frequent communications with white merchants from Holland and England, the Prince of Sonyo established a kind of a rival kingdom, and refused allegiance to the king. He was aided and abetted in this by the Dutch and English traders who had settled at Cape Padrao. The King of Kongo and the Portuguese made many unsuccessful attempts to subdue this province, and there are many bloodcurdling stories of the way in which both blacks and whites were slaughtered by the proud prince Dom Alvaro. The Portuguese seem never to have held Sonyo for a long time together, and this may account for the absence of stone walls and buildings such as were erected at San Salvador and Mbembe. Even the churches were built in native style of grass and bamboo, and the fortifications were constructed of earthworks. For this reason the site of the capital of Sonyo has not yet been fixed by any traveller or resident, as far as I know.



▲ TYPICAL NEUSU VILLAGE.



ONE OF THE ROCKS IN THE LUFUNDE VALLEY.

San Antonio is now the chief Government post on the Portuguese side of the river, and is a port of call to a line of steamers from Lisbon. The division of the old kingdom into provinces was not, in a strict sense, territorial. It was more a division of clans, several of them occupying the same territory, and all fighting for the ascendancy and the coveted possession of the central seat of authority. The settlement of white traders and missionaries at Mbembe and Sonyo caused those two clans to withdraw from the struggle for the throne of Kongo, and induced them to set up rival kingdoms at these places, where they had the help of the Europeans. Mbamba and Kongo kept up a friendly alliance, owing to both being under the Portuguese influence, but Sonyo became more under the influence of the Dutch, and consequently was always more or less at war with the Portuguese and the King of Kongo. The Nsundi clan, with commendable wisdom and foresight, withdrew to the cataract region out of the reach of all Europeans, and settled down to a life of comparative peace.

The old titles of Mani-Congo, Mani-Mbamba, Mani-Mpangu still appear in the present day as Nekongo, Nembamba, Nempangu, etc. It is worthy of notice that the King of Kongo in those days held the title "Mani" in common with the rest of the nobility. The titles "Ntotela" and "Ntinu Lukeni" are of later origin, and are such as no other person ever aspires to. The Portuguese are responsible for some of the present-day titles, such as, *Nosso* (*nosso principe*), *Capitau* (*capitão*), and *Tulante* (*tenente*). These are much coveted by chiefs, and are conferred by the king upon those who are willing to pay for the honour.

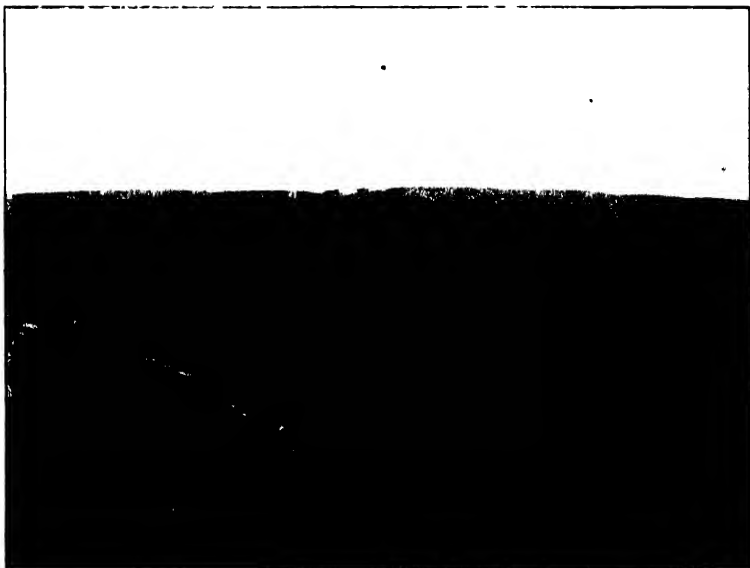
Since the appointment of a resident governor at San Salvador in 1888 by the Portuguese Government the authority of the King of Kongo has been practically *nil*, but he is still allowed to settle minor matters if his people choose to go to him. All serious matters must now be referred to the Resident, and no one is forced to consult his Majesty at all. He receives a small sum annually in lieu of what he used to extract from his subjects.

THE LAST OF THE KINGS.

Dom Pedro V. may be considered the last of the reigning kings of Kongo. He was placed on the throne over two strong rivals in 1855 by the assistance of the Portuguese, who sent a force of soldiers from the garrison at Mbembe to establish his authority. I first made his acquaintance in 1887, when I was transferred from the Cameroons to take up mission work at San Salvador. The day after our arrival we were received in state at what may (for courtesy sake) be called the palace, in reality, a mud hut with grass roof and whitewashed walls. In honour of our visit, mats, rugs, and leopard-skins covered the walls and floor of the royal apartment, and two chairs were placed for my wife and me to sit on. His Majesty was possessed of a very substantial



THE NKISI RIVER NEAR NKAMA TAMBU.



THE VALLEY OF MBEMBE.

presence, with a waist of enormous dimensions, and could walk only with the utmost difficulty. He had already taken his seat on a gilded throne placed on a raised dais at the end of the room, with a large gilt-framed portrait of "his friend," the King of Portugal, fixed to a wall behind him. His bulky person was encased in a blue and gold military uniform supplied by the Government, and in his hand he held a silver sceptre; while above all was a cocked hat surmounted with a proud red plume. On that occasion he took a special fancy to a braided dress which my wife wore, and nothing would satisfy him but that he must have a skirt-dress like it made for himself. On remonstrating with him and explaining that only ladies wore that kind of clothing, he immediately replied that it was not so, "for all the Catholic priests wore skirts too"!

A NATIVE LAWSUIT.

It was at the close of his reign that the last full-dress native court was held at San Salvador before the king. This was a case arising out of the rivalry and jealousy of two neighbouring chiefs living at some distance from the capital, and, as usual in Kongo land, it involved a question of slavery. I spent the best part of three weeks in witnessing this extraordinary travesty of a "court of justice," and it afforded a unique opportunity for the study of Kongo laws and customs, as well as an insight into native thought and character.

The course of procedure in a Kongo lawsuit is very simple and primitive, and also very expensive to both parties in the dispute. This characteristic is shared in common with a higher civilization, and serves as an inducement to ordinary folk to live at peace with one another. Where the African system differs from our civilized notions is in the fact that the judge does not allow counsel and lawyers the monopoly of fleecing their legal victims, but claims the lion's share of the proceeds for himself, and justice is therefore bought with a price. This is limited only by the wealth of the disputants. Before the case is heard in public, each party separately and secretly appears before the king and his counsellors, and for weeks these interviews continue—the victims emerging each time from the king's palace poorer by many pigs and pieces of cloth. Not until all the young men of the family are transferred to the king's hands will he commence the public hearing. Then on a fixed day the case is opened with much pomp and dancing and shouting in the "mbazi a nkanu," and for days and weeks counsel on both sides and king's counsellors entertain us with song and parable and dance. It is a war of words and invectives, interspersed with a wonderful display of native dancing to the music of drums and trumpets. Now and anon counsel in charge of the case advances into the open space before the king, and performs one of his elaborate exercises. With a long spear in his hand, a fine leopard-skin dangling in front, with the tail trailing on the ground, and an extra long patchwork



ON THE MBIDIZI RIVER.



CANOE FERRY AT THE LUFUNDE CONFLUENCE.

velvet cloth flowing from his shoulders, he presents a fine figure. His movements are so nimble and quick that the skin and cloth are kept in a constant whirling motion, and when the climax is reached, one is driven to the conclusion that the skirt-dance of Europe is, after all, of African origin. Then he suddenly comes to a standstill in a stooping position facing his opponent, glares at him like a wild beast for a full minute or so; then with a leap he flourishes his spear, and swings it around his head, and finally drives it into the ground with a stamp of the foot, as much as to say, "Thus I shall deal with you." These scenes are in the way of application to the arguments, which appear in parable and song. All this is instructive and entertaining to the crowd looking on, but it has no connection whatever with the verdict which is to follow, and they know it. That had been settled privately when the fleecing took place.

NOKI AND ZOMBO.

In a paper which I had the honour of reading before this Society six years ago (see *Geographical Journal*, May, 1902), I described the geographical character of the country lying between the Congo and the Nkisi river, including the districts of San Salvador and Zombo. During my last stay in Africa my headquarters were at Kibokolo, nearly 100 miles by road to the east of San Salvador, and 20 miles to the south of Makela, where there is a Government military post, and a small settlement of Portuguese representing about twenty trading companies. There is a caravan trade route from Noki on the river, passing through Kongo and Zombo, and leading right away to the Kwangu river at the extreme north-east corner of Northern Angola. The Government is now engaged in constructing a road 13 feet wide to facilitate the overland transport of rubber and other produce from Makela do Zombo to Noki for export. This will be completed this year, and will be a boon to all the native carriers, and should assist materially in keeping the rubber trade from entering into the Congo State.

The general character of the country is much the same all along, except that on the plateau, which we ascend 40 miles from the capital, it is much cooler, and one breathes more freely. My personal experience is that on the highlands of Zombo I can travel with less fatigue and fag than on the lower levels, but one must be careful of chills during the night, for it is quite cold about three or four o'clock in the morning. San Salvador stands at 1840 feet above sea-level, while on the plateau we are over 3000 feet high. At Kibokolo we are 3250 feet, but towards the east there is a gradual depression to the river Nkisi, which is about 2500 feet. Between that and the Kwangu there are some stiff hills, with a gradual descent to the rivers Kwilu and Kwangu.

THE COW COUNTRY.

My travels from Kibokolo have been mainly to Ndamba, Nkusu, and Mbamba. These routes marked on the map are the results of various journeys, and much of the ground has been covered more than once. One of these was an attempt to go through Ndamba to Sonso and



A ZOMBO MAN.

Pombo in search of the "cow country," whence a good supply of cattle is brought for sale to the white traders at Makela and Ndamba. But we only succeeded in going as far as Nlanda, where we met with a hostile reception from the natives, and my carriers refused to risk their skins any further by crossing the Nkisi into Sonso. On our way we visited some Portuguese traders, who had recently opened establishments at Sangi, and who were doing a good trade in rubber. Since then several others have come from Mbembe and Ambrizette, including representatives of two English firms. Much of the trade from the interior is now diverted to Ndamba, and the produce is chiefly sent

from there to Ambrizette and Moculla, but some portion finds its way to Noki through San Salvador. An attempt has been made to develop the cattle trade in this region, and for this purpose two or three trading firms established agencies at Nkama Tambu, a place close to the river, on the higher reaches of the Nkisi. The experiment has not succeeded, owing to a large percentage of the beasts dying before they could be sent to Stanley Pool or Noki. On my way back I visited Nkama Tambu, and found there the one remaining white man, suffering from fever and in a very weak state of health. It was pitiful to see this man lying in a rickety canvas deck-chair, in a wretched grass hut, among his barter goods, and, without any sort of civilized comfort, eking out his miserable existence. In front of his "shimbek" there were about a dozen bullocks, much in the same condition as himself, tethered in the grass; and he told me they were the survivors of about eighty heads which he had bought. He was anxious to assure me that he had need of nothing in the way of food, and that in a few days he expected a countryman from Noki to relieve him. I was able to leave him some medicines, of which he was in great need. Poor man! a month or so later I heard of his death.

It is difficult to account for the great mortality among the cattle and other animals in this zone. No doubt the coarse grass is unsuitable, but the chief cause is generally attributed to the tsetse fly, which is very common. At our mission in Kibokolo we have experimented with cattle, mules, and donkeys, but they all sickened, and died in about six months. The disease in these animals is very similar to the sleep-sickness among the natives. This terrible African disease is not, however, so prevalent in Zombo as it is in the lowland and valleys, and I am told that in Ndamba it has not yet been seen. Is this attributable to the higher altitudes and the absence of any extensive swamps on the plateau? The streams are never sluggish and stagnant in Zombo and Nkusu, even the Nkisi river in its higher reaches flows in its rocky bed at a rapid pace. This, added to the sandy character of the soil, shows the natural drainage of the country highly satisfactory.

THE NKUSU PEOPLE.

Two years ago (August to October, 1905), in company with my wife (who has always travelled with me, and assisted me in my observations for some twenty years), I made a journey through Nkusu into Mbamba, visiting on my way the celebrated but now abandoned copper mines at Mbembe.

The Nkusu district is the most populous I have visited in the whole of my journeyings through Northern Angola. The villages are numerous, and the inhabitants generally seemed to be strong and healthy. I always judge of the prosperity of the country by the area of land under cultivation. The extensive plantations of manioc, maize,

beans, sweet potatoes, and other native products point to the inhabitants being industrious and prosperous. The Nkusu folk also engage in trade like all the other tribes, and spend much of their time away in the rubber markets. This being a free trade in Portuguese Congo the natives make good profit by it. The highest altitude I have registered on the plateau is in this district, being 3600 feet above sea-level.

I cannot help comparing this district with that of Kidia, on the east side of the Nkisi, where we passed through some of the most wretched villages I ever saw. There was hardly a hut fit for any human being to live in, and all were in a tumbled-down condition. The people were ill-fed and dirty, and the children—the few I saw—were feeding on palm-nuts and raw manioc. We came to two villages close to each other, and found that all the inhabitants had died of sleep sickness. The carriers entered some of the huts and saw the bodies of two or three in the last stages of decomposition on the floor. These were possibly abandoned by the small remnant who had fled before this terrible scourge of Central Africa.

It was, therefore, an agreeable change to travel day after day among a bright and prosperous tribe of people. But even there we came across some disagreeable scenes and cruel customs. One day we arrived at a village where they were just preparing the body of a woman for burial in the Lueka river close by. Our carriers, always attracted by a funeral feast, went to look on, and one of the lads ran back to tell us that they were going to bury a four-days-old baby with the mother. I hastened to the spot just in time to see the grandmother pulling a native cord and fastening the living babe to the neck of the dead mother. Amidst great confusion and wild protests, I rescued the child out of her hands and carried it to my wife. It only lived, however, ten days, but we remember with horror that the child had been left for twenty-four hours to suck at the breast of a dead woman. The burying of infants with their dead mothers is a common practice through the whole Kongo region, except where there are missionaries or Government officials to stop it. I have heard of one father who reared his motherless child with native beer (*mbamvu*) and palm wine, but I know of no other case outside the members of Christian communities.

THE LOWLANDS.

Travelling in a south-westerly direction, we soon came to the confines of Nkusu, and descended the steep hill from the plateau into the lowlands of Madimba. In less than an hour's walk we had descended 1000 feet. Standing on the brow of the hill, we could see a long distance ahead, and I found no difficulty in ascertaining the position of several important points, such as the course of the Lufunde river, and prominent heights on the Nkanda plateau, as well as several castle-like rocks of lime and quartz stone on the right. Mongo wa Nbumba ("the

hill of mystery ") looked very impressive, raising its head above all other hills on the Nkusu plateau, and for several days it served for a good landmark. The villages in this district are small and few, and the people complained bitterly of the destruction of their plantations by the wild pigs. These animals are greatly feared by the natives, who seldom attempt to hunt them, their flint guns being ineffective. The springbok and various kinds of antelopes are very plentiful in this region, and they are hunted not only by the natives, but by the leopard and the wolf. Arriving at a village early one afternoon, we found the little community greatly excited, the women running home with their children from the plantations as for dear life. We soon learnt that a pack of wolves (*mevwa*) had appeared, driving before them quite a number of antelopes. It was feared that the wolves would attack the women and children, but fortunately they passed by after their quarry. According to the natives, the wolves came sometimes and carried away the children. I was disappointed at missing a view of them, as I have never seen an African "wolf."

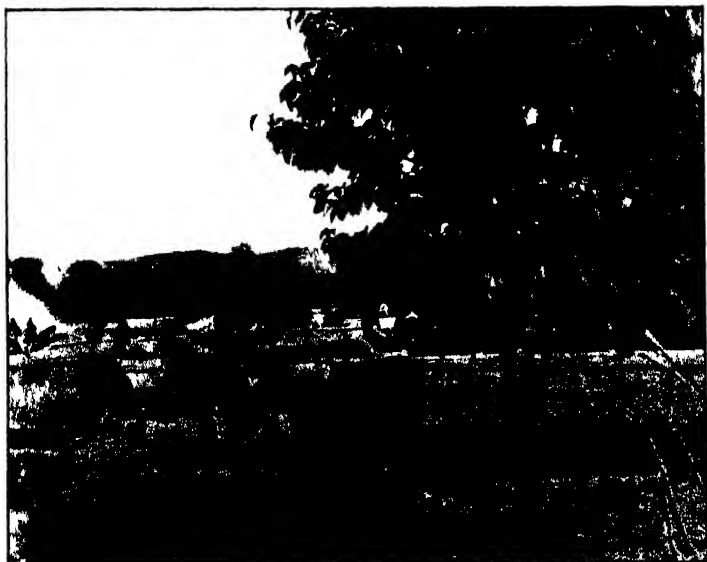
The river Lukunga, which we crossed in a canoe at the ferry known as Kiteta, was a great surprise. It joins the Mbidizi river a few miles below the confluence of that river with the Lufunde, but the volume of water in the Lukunga is about equal to that of both those rivers at that place. This important river has not appeared in any former map that I am acquainted with.

MBEMBE.

Two more days brought us to Mbembe, noted for its rich copper mines, and the site of the Portuguese Mission of three hundred years ago. We found there representatives of seven trading houses, who showed us every kindness and hospitality during our short visit. Since then I understand that on account of the diversion of trade to Makela and Ndamba they have closed their establishments, and the place is quite deserted. Unfortunately, the old mission ruins were so covered with bush and vegetation that it was impossible to properly examine them or to secure a photograph. One could see at a glance that the buildings must have been far inferior to those of the churches at San Salvador, and the ruins were not nearly as interesting. A more modern church was built fifty or sixty years ago for the use of the garrison and miners. This had been re-roofed and converted into a "magazine" for barter goods by the Congo Portuguese Trading Co. Such an act of desecration of holy places I did not expect to see even in Central Africa. The altar-place was literally covered with a pile of "converted" rifles stacked high to the roof of the building, and on each side were some hundreds of demijohns, containing trade rum and proof spirit, which by common consent to-day is considered one of the



"NLONGO" MASKS.



A KONGO VILLAGE SCENE.

greatest curses of this part of Africa. It is much to be regretted that the Government has not prohibited its entrance into the interior.

On the brow of the hill, in a splendid state of preservation, stands the little fortress, surrounded by a dry ditch, which accommodated about two hundred soldiers between the years 1850 and 1860.

THE COPPER MINES.

It was about the same time that the Portuguese made an attempt to work the copper mines, which had hitherto been worked by the natives in a most primitive way with the small hoe as the only implement. Some Cornish miners were engaged and imported into the mines, but the bad climate, coupled with worse provisions and no adequate accommodation, proved too much for them, and they soon became a prey to malarial fever. Most of them died straightway, and the experiment collapsed. Monteiro gives his experience and views of these Cornishmen, but his prejudices and self-conceit are so evident that his version of the failure needs careful weighing. However, he is right in saying that the valley is very rich in malachite deposits, and that the means of transport at fair rates are the only difficulty in the way of a profitable working of the mines.

A few months previous to my visit a well-known Portuguese engineer, Major Alfredo Freire Andrade, a gentleman of wide experience in South Africa and elsewhere, made a thorough survey of the mines, and I understand that his report confirms the view that there is a very rich deposit of sulphate of copper in the Mbembe valley, and that in some parts there are thick veins of almost pure malachite. Our last consular report refers to these mines, and says "that it has been established beyond doubt that copper exists in great quantities in the form of pure malachite, tests in London, Paris, and Lisbon having given high percentage. At present a British firm is interested in these mines." A scheme for the construction of a branch line in connection with the Loanda-Malange Railway, to run north through Mbembe to San Salvador do Congo, is engaging the attention of the Government; but the present condition of the Exchequer does not give much encouragement for our hopes. Such a railway would undoubtedly be a most potent factor in developing the resources of the country quite apart from the mines.

Mbembe of to-day presents the appearance of a deserted and tumble-down encampment. The breast of the hill is dotted with ruined portions of miners' dwellings, and rusty pieces of old machinery are scattered all over the place. The one redeeming feature in the landscape is the beautiful Mbembe peak, a symmetrical mountain standing erect a little to the south of the mines, culminating in a round peak about 2300 feet above sea-level.

THE RETURN JOURNEY.

Leaving this old historic place to the vandalism of the trader and its own desolation and decay, we proceeded on our journey, and soon crossed the picturesque stream of Lukeye, and at the end of a day's journey we reached Mabaya, where our colleagues, Mr. and Mrs. Cameron, had established a mission station under the auspices of the Baptist Missionary Society.

After spending a happy week with our old friends, we resumed our journey, and travelled due north in the direction of San Salvador. With the exception of a few rocky and picturesque streams which we crossed, the country between Mbenbe and Kongo is most uninteresting. Three days after leaving Mabaya we came to the Mbidizi river, which we crossed in a dug-out canoe just below the confluence of the Lukunga. The river scenery here is very fine, and while the carriers and loads were being ferried across by the natives in a canoe, I took some photographs and boiled thermometers. Two hours' march from the river brought us to Kimbubuzi, whose market has been notorious for its extensive slave-dealing for generations, and even now such sales are not unknown.

Here we turned eastward, and traversed the unfrequented road towards Nkusu. We crossed the Mbidizi again at the Lufunde confluence where there is a canoe-ferry, but being nearly at the end of the dry season we were able to ford the river with safety, thus saving much time in loading and unloading the only available canoe.

All along the road from Mabaya the poverty and misery of the people was most depressing; food for carriers was very scarce, and we were forced to fall back on tinned provisions, which we generally manage to avoid. After two more days along the Lufunde valley, we were glad to ascend the plateau once more to the land of cheer and plenty. The men bought sufficient food at the first village, and, to make our happiness complete, we had no sooner arrived at Nkusu Mpumbu than a heavy shower of rain fell—the first rain of the season—which was most refreshing. No one who has not experienced the long months of a dusty and oppressive tropical dry season can fully appreciate the joy and exhilaration of the first shower of rain. On the highlands of Nkusu and Zombo the rains begin a month earlier than on the lowlands. When, two days later, we reached our home at Kibokolo there was general rejoicing, for the carriers, as well as ourselves, were warmly welcomed by their friends, and we were not sorry to settle down into routine station work for at least a month or two. We had been away about two months on the tramp.

HABITS AND CUSTOMS.

While it is true that the habits and customs of the natives differ in matters of detail among the various tribes inhabiting Kongo, Sonyo,
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Zombo, Nkusu, Ndamba, and Mbamba, it is also certain that they all come from the same stock, and speak the same language with slight variation of dialect. A traveller unacquainted with the Kongo language might think that in Ndamba they speak a different dialect altogether, while, as a matter of fact, the difference consists mainly in the introduction of the aspirate for the sound *v* in Kongo. This slight change has a peculiar effect in their talk. "Evata" becomes "hata," and "vava" is "haha."

There are slight differences in their dwellings. The Mbamba people have their houses made of "wattle and daub," while the other tribes build theirs of grass and bamboo.

In the matter of preserving bodies for burial, Kongos, after the usual "binding" in cloth, keep them for two or three months in their houses, where a fire is kept burning; but in Zombo they are suspended on two forked sticks in a dug-out vault in the ground, which is covered over with palm branches and earth. Sometimes the body is placed under a specially built grass roof in the open. This is not considered a burial, and four or five years ago they brought out the body of an important chief for a big funeral feast and dance that had thus been preserved for over twenty years. In other districts the dead are thrown away into a river, or into the bush to be devoured by jackals and vultures. These differences in customs are, however, of no importance, and are mere accidents; the whole sociology and native institutions of the country are the same. The people are governed by the same general laws, which are no less "laws" because they are unwritten.

THE BLACK MAN'S MIND.

To rightly understand the people of any country, one must pay special attention to *the most important things from a native point of view*. The mischief is that we take for granted that the savage African is too low for us to take his point of vision. To get "behind the black man's mind" is perhaps not such a difficult task, if we can forget a little of our modern civilization, and superior knowledge and self-conceit. Were we to study more closely our primitive ancestors in the caves and oak-groves of ancient Britain, we might become better qualified for a sympathetic study of the African. Instead of laughing at and ridiculing native superstition and witchcraft, we would do well to try and find out what lies behind and below it all.

RELIGION.

Without doubt the most important thing in the eyes of a savage is his *religion*. It is a matter of life and death to him, and I pity the superior and more enlightened man who laughs him to scorn, and holds his superstitious rites up to ridicule. Truth is truth wherever it is found, be it hidden under the silly rites and superstitions of a savage

people, or in the more elaborate and decorous ceremonies of a ritual Christian Church. None are essential to the fundamental principle upon which the fabric is built. I have satisfied myself, after twenty-five years of life among them, that at the bottom of African fetichism there is the fundamental belief in the existence of God and in the reality of the human soul. No missionary has yet, to my knowledge, been compelled to introduce the name of God into any of the Bantu languages. The name "Nzambi" for "Supreme Spirit" is of native origin, and not introduced by the Portuguese, and has been adopted for "God" by all missionaries in their literature. The same is true in regard to the name for "devil." The oft-repeated statement made by missionaries and travellers that the untaught native has no idea of the existence of God is not correct; what they mean to say is that he has no knowledge of what God is, which is quite a different matter. The lack of this knowledge *about* God, while firmly believing that God *is*, accounts for the wonderful and complex system which we, in our ignorance of the inward meaning of it all, call "fetichism."

This is a subject most tempting to any student of comparative religion, and one which I must resolutely fight against in this paper. The point which I wish to emphasize is, that fetichism, as a religion, is based on scientific truth. The *development* of their views does not concern us just now, but *everything* in connection with native religion is not evil. There is what may be termed a "white art" as well as a "black art," and the great majority of fetiches and charms are intended to *protect* from evil, and not to *attack* innocent folk. So in the study of native religion it is most important to distinguish the one from the other.

SOCIOLOGY.

I have dwelt on this subject in order to say that this "white art" in fetichism pervades the whole sociology of Kongo land. All native institutions and government depend on it. Secret societies, such as the Nkimba, Ndembo, and Nlongo, bind the communities together in one strong army under the command of the witch doctors. The reason that the King of Kongo has more power and authority than any other is that he possesses a more powerful fetich than anybody else.

The origin of such institutions as polygamy and slavery can hardly be traced to their religion, although they are mixed up with it, and are important parts of their sociology. Indeed, most of the disputes and petty wars in the land arise out of these two institutions—there is always a slave or a woman in every palaver.

Owing to the general prevalence of polygamy, the laws of property and succession are very peculiar. It is never from father to son, but from uncle to nephew on the mother's side. A man's real children do not count—the eldest son of the eldest sister is always the heir.

SLAVERY.

But perhaps of all the African institutions the least understood is that of SLAVERY. The horrors and abominations of the slave trade have so outraged our consciences that we find considerable difficulty and very little patience in inquiring into the system itself.

In the early days of African warfare, the disposal of prisoners of war soon became a serious question. The vanquished were captured and made to serve the victors. When these became numerous among their captors, they became a menace and a peril, for at any time they might rise in insurrection or join a threatening enemy. The only remedy was to put them to death. This custom of killing prisoners of war led to the institution of cannibalism. In time of war food would be scarce, and the savage, when suffering from hunger, could not permit such waste of good flesh. This economic reason, coupled with the fact that a savage considers the eating of an enemy's flesh, and especially his liver, the highest form of triumph, is sufficient to account for the taste for human flesh. It is a remarkable fact, vouched for by Grenfell and several of my friends stationed in cannibal districts, that women do not practise it—a female cannibal is unknown in Kongo. It is the men—the fighting portion of the community—that eat human flesh, a fact which shows, I think, that the institution is the outcome of the exigencies of savage warfare.

Slavery, therefore, is a decided step in advance of cannibalism and general slaughter; and no doubt the captives themselves appreciated the improvement. With the development of the slave trade, and the demand for slave labour on the coast and elsewhere, the tribes in the interior found it more convenient and profitable to rid themselves of their surplus prisoners of war by exchanging them for other merchandise. Then finding it a lucrative trade, they waged fresh wars for the sake of obtaining further supplies, and slave raids became common. After that came the ivory trade, which involved the capturing of men and women to carry the article to the coast, where they were sold along with the burden, and thus we have what has been facetiously termed "black ivory." To-day it is the rubber; and slavery appears in various forms, but always profitable. All of us now believe in the doctrine of evolution, and this I conceive to be the evolution of slavery in Africa.

DOMESTIC SLAVERY.

But we must distinguish between the SLAVE TRADE and DOMESTIC SLAVERY. It can easily be seen that a victorious tribe, wishing to strengthen itself and add to its number and importance, would naturally keep some of the best-disposed of the captives to work for them and to fight for them. Many of them might prefer this arrangement to returning to their former clan, provided they are kindly treated. In

course of time they would marry into the tribe and become a part of the family. This condition of things is called "domestic slavery," and it holds an important place in the social system of the country. Technically, the principle of ownership is the same, but it is regulated by well-known general laws. In practice the life of a domestic slave differs very little from that of a free man. It is against the custom for him to eat with his master, but he mixes freely with the family, and eats with them. Very often a slave is given a free woman of the family for his wife, and is treated as one of themselves. In point of fact he is still a slave. He cannot possess anything apart from his master. He cannot redeem himself, neither can his owner make him a free man.

Apart from war and kidnapping, there are three ways by which domestic slaves are procured: (1) by decision of the king in a lawsuit, (2) in repayment of loans advanced at exorbitant interest; (3) by self-made slaves, who, having no family or relatives, seek the protection of another. This last-mentioned class is very numerous. A man who has no family in Kongo has no status, and life is almost intolerable. He is an outcast, and before he can get any protection or marry a wife he must attach himself to some family as a domestic slave. To such a system of domestic slavery is equal to a city of refuge.

Then we must not forget that the owner is responsible for his slave in every respect. Not only has he to keep and feed him, he must also supply him with a wife—an expensive article of luxury in Africa. He is also held responsible for all his evil deeds—a very serious matter sometimes. He must pay all fines and damages for crimes committed by his slave. A recalcitrant domestic slave can always involve his master in serious difficulties, and if his action is persisted in, his master, in pure self-defence, is forced to dispose of him.

A DIFFICULT TASK.

Thus it will be easily seen that this institution is most complicated in its relation to master and slave, and it lies at the very foundation of African society. It is this that makes the whole question of dealing with slavery a difficult one. The slave "trade" can be abolished by the firm hand of Government at any time by stopping the exportation of natives. It is not enough to say that no *slaves* are exported, when hundreds of natives are annually shipped from Angola to the islands of San Thomè and Principe as "*serviçãos*." The native knows no other name than slavery to this business, and I have personally come across a good deal of it in Portuguese Congo. The demand for "*serviçãos*" creates and encourages the demand for slaves. The interior of Angola is being robbed of the people who are absolutely essential to the development of its own resources. If this system is done away with, the internal slave traffic would die a natural death. It is very gratifying to note

that the great cocoa manufacturers of this country who have interests in the plantations on these islands have taken the matter in hand. The representations they have made in Lisbon seem to have already borne fruit, and it is to be hoped the system will speedily be abandoned, and the just rights of the natives conceded.

Domestic slavery cannot, however, be dealt with in this way without seriously upsetting the whole social life of the people. And we have no right to attack any institution of the natives, however faulty, unless we offer them a better one, and show them a more excellent way. This can be accomplished only by patient and persistent labour and training, and I venture to think that this is and ought to be the especial province of the missionary. The true missionary, in the performance of his higher spiritual duties, will not fail to guide his people and instruct them in the ordinary things of life, and fit them for their duties in the advancement of their fellow-men and the development of their own country. But he must deal with principles, and demonstrate the true relationship of man to man as well as of man to God.

There is one way of dealing with this question of slavery which all lovers of freedom must vigorously oppose—that is, the so-called “redemption” of native children. The intention has always been good; but has it ever occurred to those who adopt the system that the amount paid for one child is enough to buy three others in the interior, and that they thus directly stimulate the slave trade? Recognizing the great evil arising from this well-meant but unwise practice, the Society with which I am connected some years ago issued strict instructions to all its missionaries not to adopt this plan, except under very unusual circumstances. I venture to commend this rule to all classes of Europeans who have to deal with natives.

I take this opportunity to express my gratitude to the officers of the Portuguese Government for their invariable courtesy and assistance in matters concerning the welfare of the natives. Whenever the missionaries have brought to their notice cases of cruelty or oppression, they have always acted promptly and justly. Especially would I acknowledge the valuable services rendered to the natives of Kongo by Major J. Heliodoro de Faria Leal, who has acted as the Government representative at San Salvador for many years.

Slavery in Portuguese Congo has no acknowledged status, and every man and woman can claim perfect freedom by appealing to the resident. Under existing circumstances, so far as domestic slavery is concerned, it is all that can be expected from any Government. The total abolition of this system must gradually advance side by side with the intellectual and moral development of the people.

In conclusion, let me say that the future of this region does not depend on its copper-mines, or its possible wealth of gold, or even in its present rubber and coffee trade; it rests on the development of the

African himself. The native must be rediscovered. Hitherto the labour demanded from the black man has been mainly of a servile nature, and much of it "forced service." The "gospel of labour" will have no attraction for him as long as it is void of dignity. Industry is not restricted to mines. The great wealth of the country is in the soil, and if the African can be made to believe this, a new era will soon dawn upon the race. But the native conception of labour must be utterly changed. At present the bulk of the people are middlemen—acting as collectors and distributors of the wild produce of the land to the white men. The cultivation of the soil is left to the women; the men, during the intervals between trading expeditions, spend their time in fishing, hunting, and talking palavers. Now that white men are entering the interior markets, the occupation of these middlemen is taken away, and what is needed at the present juncture is a mighty prophet of labour who will inspire the people with dignity and self-respect, and show them that honest labour put into the soil will bring its own reward. Let the native know that his cultivated piece of ground is secured to him and his family, without extortionate taxes in kind on the produce, and he will immediately begin to plant rubber trees, cotton, and coffee, and the prosperity of the land will be secured. Then, instead of "rubber" being considered the sign of death and of cruelty, it will become the means of bringing prosperity and gladness into the lives of millions of the sons of Africa.

Before the paper, the PRESIDENT: Those of you who were present at our meetings in the spring of 1902 will remember that the Rev. Thomas Lewis read to us then a valuable paper on the Portuguese Congo. It is on a portion of that region with which he did not then deal that he is going to read us a paper to-night. Mr. Lewis is one of the highest authorities we have on the region in question, as he has lived there for some twenty-one years. That is not the whole of his record in Africa. Mr. Lewis went originally to the Cameroons a quarter of a century ago, and he was there at that interesting time when the German flag was hoisted. I also understand that Mrs. Lewis has lived in West Africa for twenty-four years, so that it cannot be so black as it is painted. Mr. Lewis is a Baptist missionary, and I think that all of you who know anything about equatorial Africa will agree, without going into any question of religion, that missionary effort there has been an unmixed blessing. Mr. Lewis has been engaged in work that involved his travelling extensively in various parts of the country, some of which had never before been visited by Europeans. I will now invite him to read his paper.

After the paper, the PRESIDENT: The discussion to-night will be short, owing partly to the influenza, and partly, I suppose, to the weather. I propose to open that discussion, not with any remarks of my own, but by reading an interesting letter from one of the best authorities on the Congo we have in this country, our distinguished Vice-President, Sir Harry Johnston.

"I much regret that ill health prevents my being present at the reading of Mr. Lewis's paper to-night. I shall look forward with interest to reading that paper when it appears in the *Geographical Journal*.

"I am shortly publishing a comprehensive work on the regions of the Congo,

derived largely from the researches and notes of the late George Grenfell, Holman Bentley, Thomas Comber, and W. H. Stapleton, together with the work of other members of the great Baptist Mission on the Congo, happily still alive, such as William Forfeitt, John Whitehead, J. H. Weeks, H. Sutton-Smith, and R. Glennie. This accumulation of ethnographical and linguistic material has been placed in my hands by the Secretary of the Baptist Mission for analysis and publication. The maps are mostly due to the accurate surveys of George Grenfell, and nearly all the beautiful photographs which will so aptly illustrate these researches are by Grenfell and William Forfeitt. The result will be such as to surprise such foolish people as do not realize that nowadays most missionaries are at the same time men of science, in one direction or another, earnestly anxious, at no profit to themselves, to place before the world as much accurate information as they can obtain concerning the countries in which they dwell.

"I have, of course, been personally acquainted with the work of the Baptist Mission in West Africa from 1882 onwards, in the Cameroons and in the Congo. I have generally found that it was better known, understood, and appreciated in Belgium, Germany, and the United States than it has ever been in Great Britain. So far, it has only been the Scottish University of Glasgow that has had the sagacity and discrimination to confer a public distinction on a member of the English Baptist Missionary Society. This Society, it must be remembered, produced probably the first accurate philologist in African languages, the Rev. James Clarke, who illustrated the native speech of the island of Fernando Pô in 1848, but who was writing on West African languages as early as 1841, and whose ideas and theories are singularly modern when read in the light of more recent discoveries.

"The late Richard Burton, not by any means over-indulgent in his estimate of missionaries, and that equally celebrated writer on Africa, Winwood Reade, wrote quite as cordially forty years ago of the practical results and the scientific achievements of the Baptist Mission in the Cameroons.

"I have every reason to believe that Mr. Lewis's paper read to-night will be up to the standard set by Grenfell and Bentley.

"H. H. JOHNSTON."

Rev. LAWSON FORFEITT: I regard it as a great honour to be invited to say a few words from the platform of the Royal Geographical Society. As secretary on the Congo for many years of the mission of which Mr. Lewis has been a distinguished member for over a quarter of a century, I may, perhaps, be permitted to express the great pleasure it affords his colleagues that his work as an explorer, and as a careful student of African problems, receives such gratifying recognition from this great Society. Such appreciation is, I am sure, a source of encouragement to Mr. Lewis himself, and to all those who seek to emulate his example. We do not forget the great honour conferred upon another member of the same mission: I refer to the late Rev. George Grenfell, who was awarded the Patron's Gold Medal some years ago. His great work in Central Africa is well known, and his lamented death was the occasion of a valuable and much appreciated tribute from the pen of Dr. Keltie, who, I may say, always receives us with the greatest kindness on our return from abroad. Perhaps I may be allowed to express the great pleasure I have experienced in being present this evening, and in listening to the interesting and valuable paper of my friend Mr. Lewis. His views on the question of slavery—on domestic slavery, as well as of the slave trade—are, I venture to think, of great importance, and are deserving of careful consideration by all those who are devoting attention to African problems. I entirely agree with what he has said on this subject. With reference to the cruel system for providing forced

labour for the cocoa plantations in the islands of San Thomé and Principe, it has been my painful experience to travel on Portuguese ships which have conveyed large numbers of these Africans from Angola, and the hopelessness and blank despair on their faces as the steamer carried them further and further from their homes will ever remain graven on my memory and on my heart. As Mr. Lewis has said, we greatly rejoice that the important firms in England who are interested in the cultivation of cocoa in those islands have taken up this question. I had the opportunity of conversing with the special commissioner who was sent out by those firms when he visited my station on the Congo, and of expressing very strongly our views on this subject. Mr. Lewis has given us a graphic account of a native lawsuit. I have never witnessed such a trial as he describes, but I was once present at the ceremony of appointing chiefs over certain towns by the principal chief of the district, and the extraordinary proceedings were intensely interesting to the two Europeans who were observers on the occasion. The frantic rushing to and fro in the circle formed by the excited crowd of natives, the brandished sword which had evidently been handed down from generation to generation from the time of the early Portuguese explorers, and the wild shouting and dancing, were enough to make one fear for the mental balance of the performers, as well as for the safety of those sitting and standing near. Mr. Lewis's statement that to properly understand native problems, one must try to understand them from the native point of view, and to study the black man's mind, is one upon which he rightly places great emphasis. I am also a firm believer in the view that it is not difficult to induce the African to work, and to teach him the dignity of labour, provided he is permitted to reap a fair share of the proceeds of his toil. I believe that the general public in this country are coming more and more to recognize that the views of such men as Mr. Lewis, and of distinguished administrators such as the honoured President of this Society, who have spent many years in Africa, are at least as worthy of respect as the views of those travellers who spend a few weeks in rushing through a country, and then hasten to give their valuable opinions to the world. When Mr. Lewis returns to the Congo, I am sure he will go with happy recollections of the way in which he has been received by this important Society, and we may look forward, if his valuable life is spared, to hearing further from him on those questions in which the Society takes so deep an interest, and concerning those regions the highest welfare of whose inhabitants both Mr. and Mrs. Lewis have done so much to promote.

Sir T. FOWELL BUXTON: I very much appreciate the opportunity of expressing my admiration of the paper to which we have just listened, and the beauty of the pictures which have been thrown upon the sheet, and which have gone so far to illustrate the scenery among which the author has been living for so long. I think he is to be congratulated upon his paper. He has touched upon that very difficult and complicated question of the difference between the slave trade and slavery. We never can dwell too much upon that, because it is a constant source of confusion and embarrassment when these matters come under consideration, but I think we owe him a debt for what he has told us upon that. He has also told us, what some of us have known already, that there is a great deal of domestic slavery which is of a very innocent kind. We may like, as a matter of prejudice, to get rid of the name where we can; but it must be remembered, too, that there are other experiences. Now, I think the experience of Uganda bears upon it. In that case questions arose as to runaway slaves, and the chiefs came to the bishop, and they consulted him as to the right or wrong of retaining slaves. He took rather a conservative view; he appealed to the law, and to the duty of obeying the law. Well, they went away, but he told them to consider it among themselves

with the best light which they could derive from the Christian instruction which they had received. They went away, and they conferred among themselves without any direct leadership from English missionaries, and they arrived at the conclusion that slavery was contrary to the laws which they had derived from their study of the Bible, and they among themselves arranged to alter the laws of their country, and to abolish slavery. And then, again, we are often told, from the dwellers in South Africa, that no black man will work unless he is driven. Well, now there has been this experience going on in Uganda and in East Africa, and in other parts too—that certain work, like weeding, is looked upon as women's work; but if it is ploughing a field, that is regarded, I think, as suitable for a man. This has been known to be the case in Uganda. Some missionaries, some commercial persons in sympathy with the missionaries, have done much to introduce the growing of cotton, and its growth has gone on month after month steadily at the most extraordinary pace; the chief and the tribes and the villagers have embarked upon the cultivation of cotton with the utmost industry, and where they see that they are carrying on cultivation in which they are interested, and from which they derive a profit, they are perfectly able to carry on the work with such zeal as you might find anywhere else. I do not know if cotton has been introduced in that part about which we have heard to-night, but that has been the recent experience in Uganda with the cultivation of cotton, and the growing of rubber trees is becoming a considerable industry. Well, I am sure we are greatly indebted to Mr. Thomas Lewis for what we have heard, and are all prepared to express our appreciation of his lecture.

MR. HEAWOOD: So many points of practical importance have been raised by Mr. Lewis's paper, that I cannot help feeling it is somewhat to be regretted that the discussion should be narrowed down to what is, after all, a single point of interest out of many, namely, the historical point on which I have been asked to say a few words. Mr. Lewis has shown us a most interesting inscription, and I think that all students of early voyages will feel what a great interest attaches to its discovery. We must all have been struck with the wonderful state of preservation of the inscription, which has made its interpretation a comparatively easy task. That it can so easily be read is, I think, due first of all, to the hardness of the rock in which it was cut; in the second place, to the thoroughness with which the old Portuguese workman did his work; and last, but not least, to the excellence of the photograph which Mr. Lewis has put before us. The amount that we know from history of these Portuguese voyages is so scanty, that the information that we have received from this inscription is of distinct value. Unfortunately, no date is given. We know that there were two voyages of Diogo Cão—the first in 1482, and the second in 1485—and various considerations seem to point rather to the second, in which, as we are told by at least two writers, Cão was in command of a fleet. It is of great interest to have recorded the names of Cão's companions on this voyage. There are some ten names that can be read. They are very much contracted, but I think we can guess at them very closely, and at least three of them are known to have taken part in the Portuguese African voyages of the time—two in that of Bartholomew Dias, and one in that of Vasco da Gama. I cannot help wishing that Mr. Ravenstein, who is present to-night, had been called upon to speak first on this question, for I am but a humble disciple of his in these matters, and he is far more competent to deal with them. One thing, I think, has been brought out by the paper, viz. that it is not necessary to rush into the very heart of the continent to do good work, and this might supply a useful hint to those in search of a field for work in the future. I can only say, in conclusion, what an advantage I feel it to be to listen to one who, like Mr. Lewis, has lived the

best years of a lifetime in a little-known region, and can speak with such intimate knowledge of the inner life, manners, and customs of the inhabitants.

MR. RAVENSTEIN: We have listened with much profit to Mr. Lewis's paper, for his long residence in the country, his extended travels, and his knowledge of the native language enabled him to secure an amount of information on the geography of the country and the character of its inhabitants which is beyond the reach of travellers who merely rush through a country. There is one question, already referred to by Mr. Heawood, which interests me more especially. It is many years since I took up the study of the Portuguese discoveries, and about ten years ago, when Mr. Lewis was here before, I wrote a short history of Congo, which has been published by the Hakluyt Society. Since that time I have been hard at work upon a life of Martin Behaim, who claims to have commanded a ship in one of Cão's expeditions. During his first expedition Cão discovered the Congo, and erected a *padrão* at its mouth, which has been broken, and the pieces bearing the inscriptions carried off by the natives, who look upon these fragments as potent fetishes. An indefatigable traveller like Mr. Lewis might yet succeed in recovering these fragments. Fortunately, Cão set up a second *padrão* further south, which has been recovered intact, and from which we learn that his first voyage was undertaken in 1482—that is, at a time when Behaim was still at Antwerp. We may surmise that one Ferrão Vaz, a pilot, whose name is given to a river on the coast discovered by Cão, was a member of it. Our knowledge of Cão's second expedition is rather vague. We know, however, from a *padrão* at Cape Cross, that it took place in 1485. The rock inscriptions brought home by Mr. Lewis, as far as I can judge from the photograph thrown upon the screen, refer to this second expedition. The Portuguese coat-of-arms is that adopted in 1485, a short time before Cão started on his second voyage.* The inscription is most valuable, for, although it contains no date, it gives the names of a number of persons associated with Cão in this voyage. Among these names are those of three pilots and two masters whom we know to have been connected with other expeditions of the time, and five names of other persons; but among these names we look in vain for that of Martino de Bohemia, who claims to have been the captain of one of the ships. Of course I have been abused for doubting Behaim's share in this work, and I only wish one of our pretentious spiritualists would summon him amongst us, so that he might be cross-examined. I am aware, of course, that the discovery of this inscription is of no practical importance, however interesting it may be to myself and others who are interested in the history of geography.

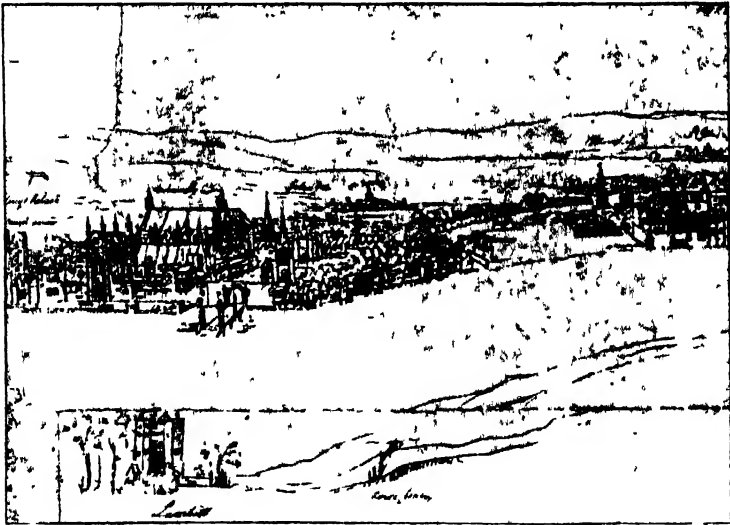
THE PRESIDENT: I will now propose a vote of thanks to the lecturer for his paper, which I am sure you will agree has been of a most vivid character. I heartily endorse all that Mr. Lewis has said about the character of the African, the treatment of slavery, and the possibility of getting the African to work.

* For designs of the two coats-of-arms see Mr. Ravenstein's paper on "The voyages of Diogo Cão and Bartholomeu Dias," in the *Geographical Journal* for December, 1900.

THE STORY OF LONDON MAPS.*

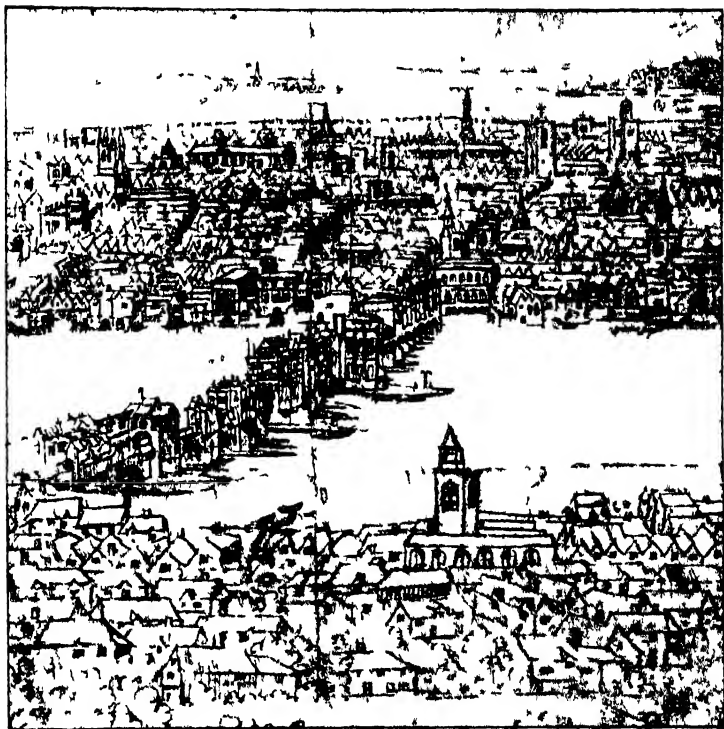
By LAURENCE GOMME.

The most delightful of all London maps is that of Van den Wyngaerde, the original drawing of which is in the Sutherland collection in the Bodleian library. Its actual date is uncertain. It shows the king's palace at Westminster as it was when Henry VIII. forsook it for Whitehall; the position of Bridewell is left blank; the tower of Holy Trinity, Aldgate, is shown standing; and the Cistercian Abbey of Eastminster is shown. Now, Bridewell was built by Henry VIII in 1522; Holy Trinity was given by the king to Sir Thomas Audley in 1501, and at some time between this year and the year of his death, 1544, the Tower was pulled down by him; and the Abbey at Eastminster was destroyed in 1539. These dates suggest that the drawing was made, or perhaps begun, *tempore* Henry VIII., and not in its usual attributed date of 1550.



VAN DER WYNGAERDE'S MAP, FROM THE KING'S PALACE TO ST. GILES.

Among interesting features of the view, apart from the beautiful representation of London Bridge, is the view of Suffolk House, Southwark, a contemporary picture of a Tudor house. It was built by Charles Brandon, Duke of Suffolk, and some of its dislodged remains



WYNGAERDES MAP, SHOWING LONDON BRIDGE

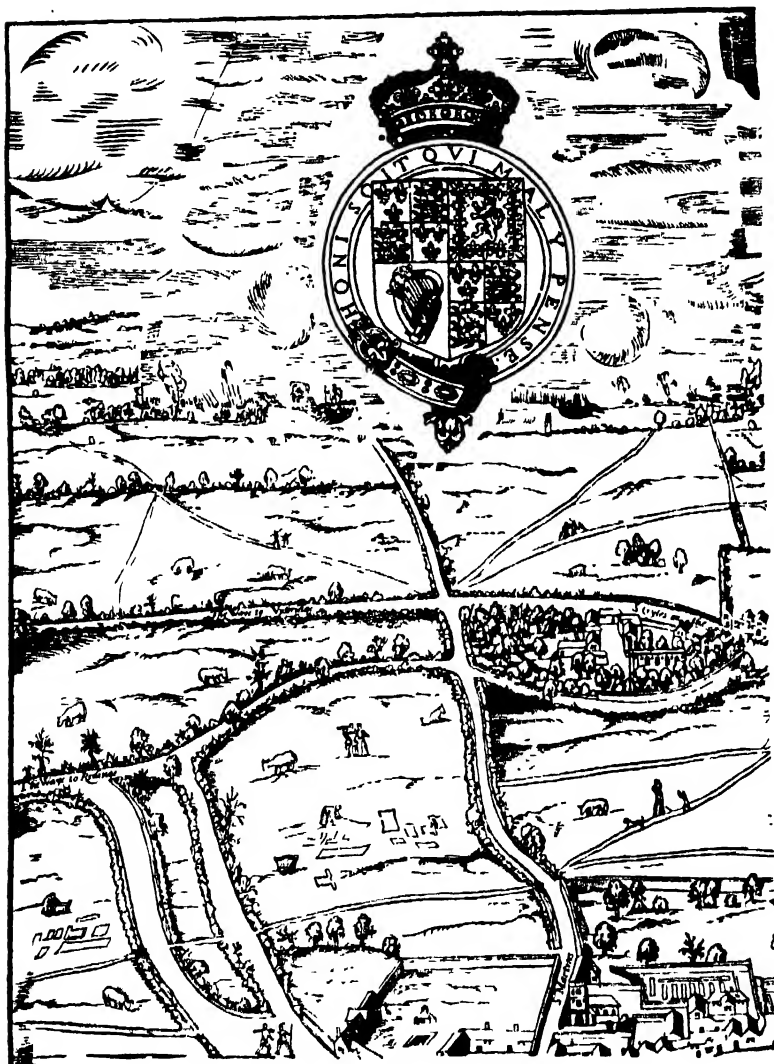
were uncovered in 1905-6 by the London County Council in running a road through the churchyard of St George the Martyr.

The "Braun and Hogenburg" map, printed in the *Civitates Orbis Terrarum*, 1572, is exceedingly interesting. The arms of Elizabeth appear upon it, the costume of the figures shown in the interesting little street scene in the foreground is early Elizabethan, and the buildings westward of Temple Bar can be dated from history as early Elizabethan. For instance, Paget Place; this was known as Exeter House before the Reformation, as Paget Place after the Reformation, from William, Lord Paget, whose property it became, later as Leicester House, when Robert Dudley owned it, later still, as Essex House, when the unfortunate Robert Devereux, Earl of Essex, lived there. St. Paul's is shown with the spire which was destroyed in 1561.

This map is to be dated, therefore, between 1558, the date of Elizabeth's accession, and 1561, at the time when Essex House (Leicester House) was known as Paget Place.

The famous Agas map has four special features.—

- (1) Bears the arms of James I.
- (2) The arms of Queen Elizabeth appear on the royal barge in the river.



Plan of London (circa 1560-1570) by Ralph Agas.

- (3) Shows the amphitheatres as in "Braun and Hogenburg."
- (4) St. Paul's appears without the spire.

Therefore Mr. Ordish dates this map a little later than "Braun and

Hogenberg"—between 1561, when the spire was destroyed, and before the Earl of Leicester took Paget Place as his residence.

The first sheet of the London Topographical Society's reproduction of this map (showing the arms of James I., which must have been engraved upon the plate subsequently) affords an interesting view of the district known to us as the Seven Dials. We identify our present Oxford Street in "The Waye to Vxbridge," and we feel that we are on the road towards Hyde Park Corner when we leave the village of St. Giles and its church (the original of the existing one) and follow the direction given, "The Waye to Redinge." The map is curiously illustrated by figures of pedestrians, cattle, and women drying clothes.

Sheet 5 shows us Charing Cross, Whitehall, and Westminster; St. James's Park and Lambeth Palace appear on the further right and left of the picture. Kinges Strete existed until the other day. The name "Whitehall" does not appear, but we have (as in "Braun and Hogenburg") "the Courte." Parliament Street was scarcely a highway at that time. The way from Charing Cross is barred except for an opening that could scarcely have admitted a coach of any size, and the way is guarded at either end of the palace precinct by great gateways—the Holbein Gate towards Charing Cross, the King's Gate towards Westminster. The cockpit, a part of the site of which, Lord Welby tells us, is included in the buildings of the present Treasury, stands looking over the park, with the lake and a bridge, in correspondence with features familiar to us to-day. You will observe the swans in the river, which were of European celebrity as a feature of Elizabethan London.

Sheet 2 shows the continuation of the road from Uxbridge, which we call Oxford Street because it is the high-road to Oxford; it enters the map on the left-hand side just east of St. Giles in the Fields, continues along Holborn, crosses the Fleet river by Holborn bridge, and approaches Newgate. You see the territory of Lincoln's Inn is enclosed, and between Chancery Lane and Holborn Bars is Southampton House, the residence of Shakespeare's patron, the Earl of Southampton. On this wall here in Chancery Lane, Gerard the botanist at this time found growing the Whiteblowe or Whitelowe grasse, "the English Naile woort," as recorded in his 'Herball,' 1597. "It groweth plentifully," he says, "upon the backe wall in Chauncerie Lane, belonging to the Earle of Southampton, in the suburbs of London."

The line of the road to Theobald's—what we call Theobald's road to-day, formerly the King's way—intersects the sheet. It passes Clerkenwell, and on the right we see the buildings of the Hospital or Priory of St. John of Jerusalem, and the southern gateway, which still exists, is shown in St. John Street, leading from Smithfield as it does to-day. Cow Cross Street still exists, leading from the Smithfield

market. Shoe Lane, leading towards Fleet Street, is identifiable under the spelling "Sohow Lane."

Sheet 6 shows the Strand, Temple Bar, and Fleet Street; the river, with the river-side palaces from Durham Place (where Sir Walter Raleigh lived) to Bridewell, once a royal palace, at this time a hospital, having been so constituted in the reign of Edward VI. On the south is Paris Garden, one of the pleasure resorts of Elizabethan London, and, according to the map, also apparently the home of strange animals.

Sheet 7 gives the line of Newgate Street and the Royal Exchange district, showing two conduits besides the great conduit of Cheapside,



THE BEAR GARDEN, THE GLOBE. VISSCHER'S VIEW OF LONDON, 1616.

with the large jars or pitchers standing in the roadway. The area between Moorgate and Lothbury is an open space. The wall is very distinctly drawn. Outside the wall in "More Fyeld" are more clothes drying, and a little to the north archers may be seen practising.

Sheet 7 comprises the St. Paul's area, showing on the south side the church of St. Saviour's.

The next map is that of Norden in 1593, representing London, as apart from Westminster. Gray's Inn Lane leads through the country to Hampstead. The village of Islington is isolated. The river of Wells, the source of the Fleet river, is delineated. The old spital, where the Easter spital sermons were preached from the pulpit cross, is marked.

The church of St. Botolph's, opposite Aldgate, is shown. The two Smithfields, east and west, are shown. The city walls are remarkably well defined. On the south side are Lambeth Marsh, Paris Garden, and on the Bank side the bear-house and the playhouse.

Norden's map of Westminster, separately printed, is also very interesting.

A very interesting view of old London Bridge is contained in the Pepysian library at Cambridge, and has been reprinted by Dr. Furnivall. In the group of buildings are St. Thomas's chapel on the left, Nonsuch house on the right; the cornmills further on the right, and the water-raising apparatus on the left.

A valuable view of London by Hondius in 1610 is given in Speed's 'Theatre of Great Britain.'

Visser's view of London in 1616, a copy of the original edition of which is in the King's Library, British Museum, has been reproduced by the London Topographical Society. Sheet 1 shows us Whitehall; Sheet 2 St. Paul's Cathedral, the Bear Garden, and Globe, after it was rebuilt; Sheet 3 the Bridge; and Sheet 4 the Tower and St. Olafa.

The Faithorne and Newcourt map of 1658 brings us to the end of the Commonwealth period. Sheet 1 of the London Topographical Society's reproduction has an excellent engraving of Westminster Abbey and St. Giles; Sheet 5 shows Westminster and St. James's Palace and the river bend (Cockpit shown by itself, in shape like the other playhouses on the bankside); Sheet 2 shows the centre of the town with St. Paul's; Sheet 4 the river, the bridge, and Southwark; Sheet 3 shows the north-eastern part of the town, including the Tower, and, as an inset, a picture of St. Paul's, to correspond with that of Westminster Abbey as in the first sheet; Sheet 6 shows the river towards the foot of the Thames, with the shipping. One most interesting relic of the time, depicted by Faithorne's map, when the now densely populated district near Soho was in a quite rural condition, is still in existence. In Archer Street, facing the rear of the Lyric Theatre, stands a farmhouse (now occupied by a firm of upholsterers and art-fringe makers). This is said to be the farmhouse of Windmill Fields. These fields, like the present Great Windmill Street, derived their name from the windmill which is shown in Faithorne's map of London in 1658, and which probably stood near the junction of Great Windmill Street and Little Pulteney Street. The fields are alluded to in a printed proclamation quoted in Wheatley and Cunningham's 'London Past and Present' (vol. 3, pp. 526, 527) of April 7, 1871: "The fields, commonly called the Windmill Fields, Dog Fields, and the fields adjoining to So Hoe."

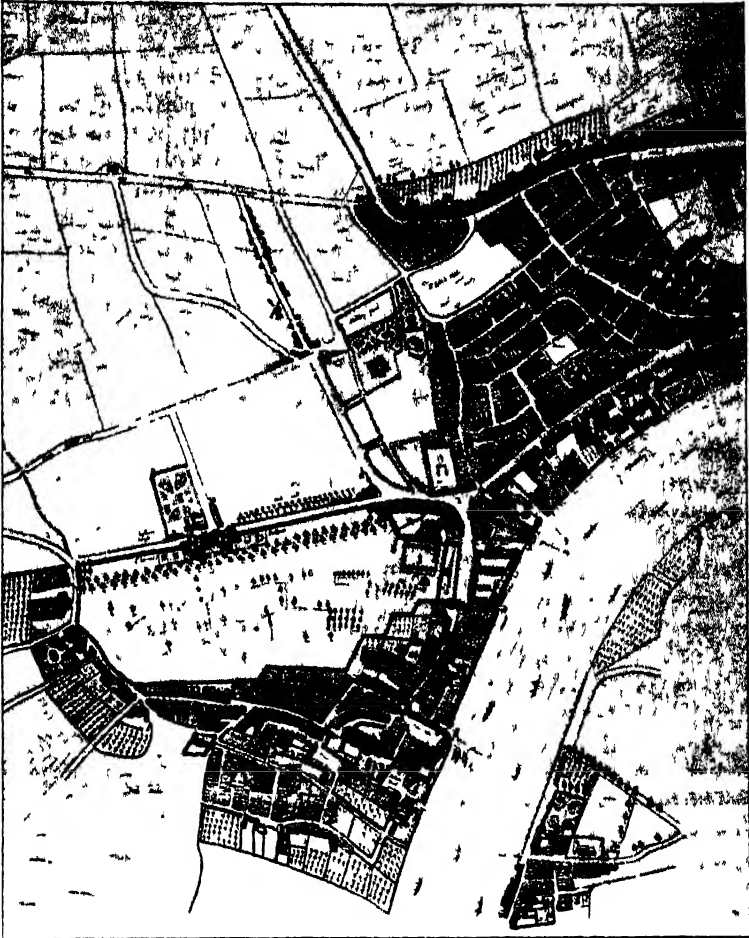
Porter's map of London (1660-1665) is the latest map before the Great Fire in 1666.

I now pass from the general maps by referring to the collection



HOLLAE'S VIEW OF LONDON, 1647, SHOWS SOUTHWARK, ST. PAUL'S, LONDON BRIDGE, THE EAST END OF LONDON, THE TOWER, AND THE RIVER.

the originals of which, by the kindness of the London County Council, I am able to exhibit to-night. They proceed in more or less regularity until they become annual from 1800. Many of these maps are of great beauty as specimens of the cartographer's art, and all of them reveal features of more than ordinary interest to Londoners.



THE FAITHORNE AND NEWCOURT MAP OF 1658.

Apart from the general maps are a whole series of special maps. Many of these are in the possession of the local authorities of London, and are of great value, though they are not always valued by their owners, even though they are owners as trustees of the public.

The map of Southwark in the Duchy of Lancaster records, and dated 1542, is, not only from its early date, but from the details it contains, one of the most interesting of these special maps. It has been reproduced in Rendle's 'Old Southwark.' This plan was probably made about the year 1542. It is quite out of scale, but affords, nevertheless, a good-enough indication of the true position of the buildings and objects it shows, while its rude representation of them in picture form gives it a peculiar interest. It covers the area from Winchester Yard on the west to Bermondsey Street on the east, and from the Thames on the north to Long Lane on the south. The greater portion of the map is devoted to the representation of the main thoroughfare through Southwark. Here, occupying prominent positions in the centre of the road, are shown the pillory, the well, and the bull-ring. On the east side of the way are the numerous inns for which Southwark was famous (the White Hart, the George, the Tabard, and others), the Gate of St. Thomas's Hospital, the Marshalsea, the King's Bench prison, and St. George's Church. On the west side the most prominent objects are St. Saviour's Church and the manorhouse, while a few inns and private houses, the court-house, and the market-place, are also represented. Along the course of what is now Tooley Street may be seen another pillory, together with a cage; and at the top of Bermondsey Street is Bermondsey Cross.

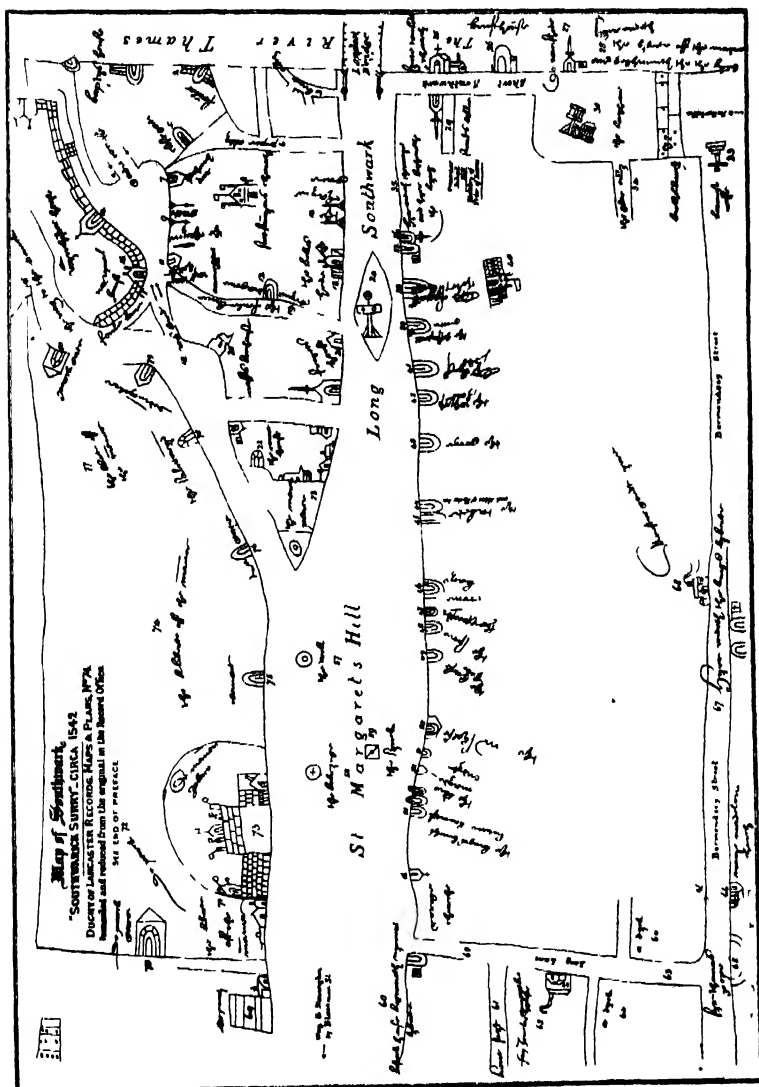
There exists a plan of Deptford, drawn in 1623, and containing memoranda by John Evelyn.

Another good example of local maps is the map of the manor of Old Paris Garden, in 1627. The map shows Copt Hall, the Mannor House (afterwards Holland's Leaguer), and an "Olde Playe House." The names of the tenants are given. Most of the houses are along Bankside. Paris Garden Stairs, Holy Ghost Stairs, and Stairs near the Barge House are shown. A portion of Winchester Parke is on the east, and The Princes Meddowes are on the west.

Hollar published a beautiful map of the western part of London, and only one copy, now in the British Museum, is known. It was drawn before the Great Fire. It is not a view, but a map with buildings delineated in isometrical projection. The dial in the centre of Covent Garden piazza is shown, and this was set up about 1668 or 1669. St. Giles Fields are unoccupied with buildings. A curious pyramidal tower, marked "Ye Waterhouse," just to the eastward of the landing stage known as Strand Bridge, and in front of Arundel House, is shown, and this is one of the works set up during the Protectorate for pumping the river water for public service. It was patented in 1655, and in all probability taken down in 1665, the year after an order was issued for its destruction by the king.

The London County Council possesses many beautiful maps and plans as originally drawn for its various predecessors, from whom it

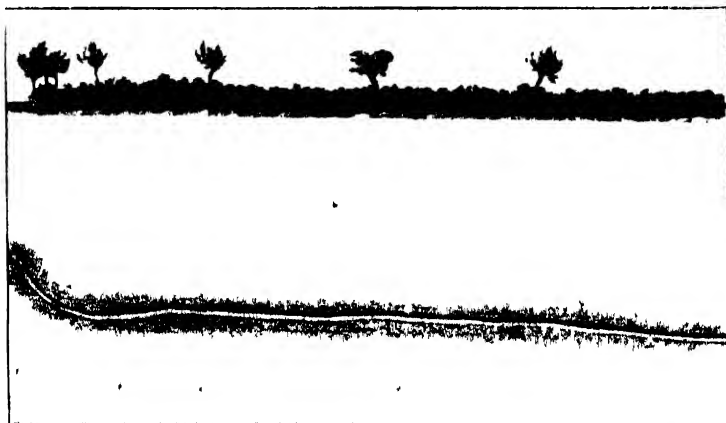
inherited manuscripts and documents of surpassing interest. One of these is a finely executed plan of the Grosvenor estate in 1723, showing its area to be nearly co-extensive with the then newly formed



parish of St. George, Hanover Square. There are plans of other great London estates—of the parish of Paddington (1824), of St. Marylebone, Paddington, and St. Pancras, showing the estates within that area; of

the old Hippodrome and neighbourhood, showing Notten Barn farm, and Portobello farm; of the Great Western and North-Western railways in the London district, with Brunel's and Robert Stephenson's signatures; and of the new Houses of Parliament, signed by (Sir) Charles Barry.

Perhaps the most interesting, however, is a survey of the river Fleet made in 1817, showing the condition of the whole line of the stream from Hampstead to Holborn, and leading us back to a London of green fields and hedges, five-barred gates and trees, with an occasional cottage on the banks of the stream. From this beautiful plan I have selected four views. The first of these shows the Fleet river just after leaving Pond Street, Hampstead, the second at St. Chad's well, the third at Bagnigge Wells,

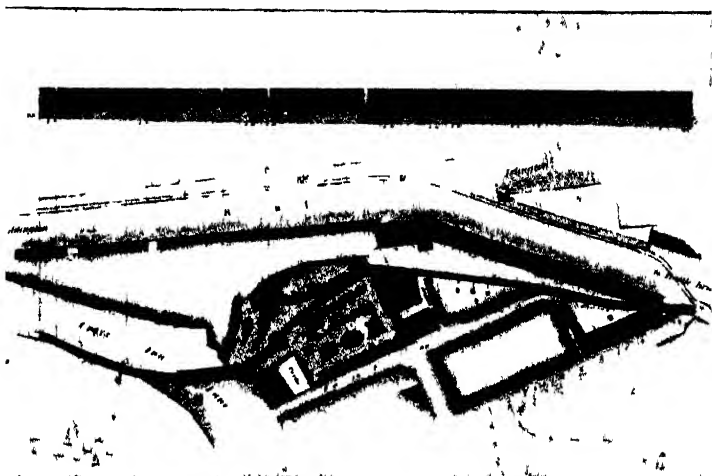


THE FLEET JUST AFTER LEAVING POND STREET, HAMPSTEAD.

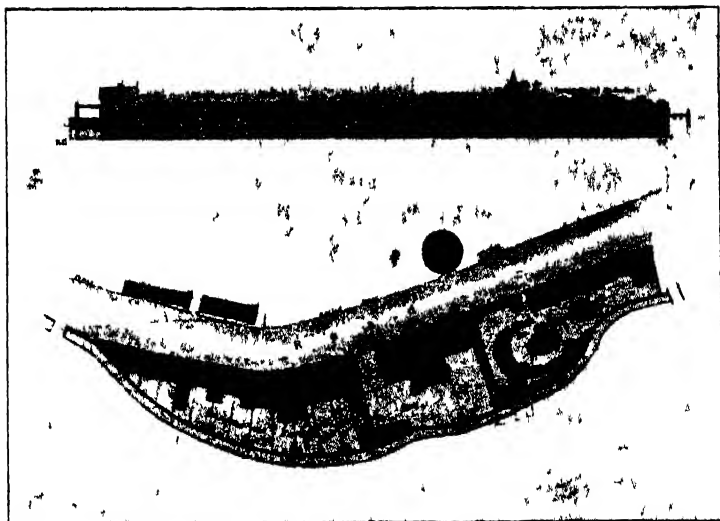
and the fourth at Saffron Hill, where for the first time we get the presence of bricks and mortar.

The ancient streams of London have been gradually converted into sewers, and plans of them are still extant. Thus the King's Scholars' Pond sewer was so called because it emptied itself into the Thames at the King's Scholars' Pond (near the present Vauxhall Bridge), on "the great level extending from the Horse Ferry to Chelsey Mead." Incidentally it may be mentioned that during the reign of Queen Anne the name of the sewer was dutifully changed to Queen's Scholars' Pond sewer. Anciently it was known as the Tyburn brook, and later as the Aye brook, and flowed down the hill from Marylebone Fields, passing near the old village of Tyburn and across the Acton or Tyburn road (Oxford Street), and the present Brook Street, through Mayfair to the Stone Bridge, situated at the "dip" in modern Piccadilly. Passing under the bridge and the high-road to Kensington, it entered what is

now known as the Green-Park. This was formerly St. James's Fields, until Charles II. enclosed them, and added the land thus enclosed to St.



THE FLEET AT ST CHAD'S WELL



THE FLEET NEAR BAGNIGGE WELLS

James's Park, by which name the whole was known until a comparatively recent period. Large ponds were formed in the course of the

sewer in this part of the park. At the bottom of the hill the streamlet passed through the gardens of Goring or Arlington House, where Buckingham Palace now stands, and along by the "coach road to Chelsea"—the present Buckingham Palace Road—and what is now Vauxhall Bridge Road to the river. At different periods the stream was altered in various parts of its course, and gradually covered in and converted into an underground sewer.

There were other small tributaries of the Thames which became in course of time underground sewers. One was the Bayswater brook, or West Bourne, which became the important Ranelagh sewer, and part of which was utilized to form the Serpentine. A glance at the map of the original winding course of this stream will easily explain the origin of the name "Serpentine." Further west was the Counter's Creek, with its tributary the Stinking Ditch.

I think I have now shown how valuable these maps and plans are for London history. I first of all introduced you to maps drawn from archaeological and historical remains; then to very ancient historical remains still surviving on the later maps; and, finally to maps for the information they give of topographical features contemporary with their own dates. Before closing my paper, I wish to say one word as to the material which exists for filling up of gaps in the maps, or for extending the information they contain in many important particulars.

. Thus, among the earliest documents belonging to the London County Council are the minutes of the Surrey Commission of Sewers, which commence in January, 1557-8. The next oldest collection of minutes is that of the Greenwich Commission, whose minutes range from 1625 to 1847; then the Poplar Commission, from 1629 to 1847; then the Westminster Commission, from 1659 to 1847; then the Tower Hamlets Commission, from 1702 to 1847; then the Holborn and Finsbury Commission, from 1716 to 1847; then the St. Katherine's Commission, from 1782 to 1841; and, lastly, the Metropolitan Commission, from 1847 to the formation of the Metropolitan Board of Works in 1855.

The value, as material for London history, of entries in these minute-books, may be realized from even a cursory perusal of some of the volumes. Witness the entry in the first volume of the minute-books of the Surrey and Kent Commission, 1557-1606 (left-hand page of folio 154)—

"1588. Henchley—Item, we present Phillip Henchley to pull upp all the pylls that stand in ye common sewer against the play-house to ye stopping of the water course, the which to be done by midsummer next uppon paine of x' yf it be undone. x' (done)."

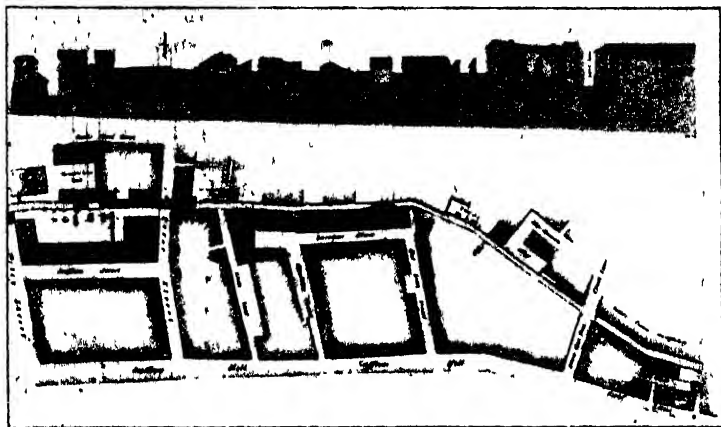
There is little doubt that "Philip Henchley" is Philip Henslow, who in 1584 or 1585 purchased the land close by the southern end of

modern Southwark Bridge, on which stood the "Little Rose" play-house, and who rebuilt the theatre in 1586 or 1587.

In the minutes of the Westminster Commission for 1662 to 1666, p. 184, occurs the passage—

"Proposals for taking away the annoyances occasioned by the common sewer at Westminster.

"Westminster lies upon a great flat, and the highest part of the soil is next the bridge, upon Mill Bank. The highest spring tides flow six or seven feet higher than the low-water mark.



THE FLEET AT SAFFRON HILL.

"Westminster and the parks is annoyed by the filth of the common sewer, which is occasioned by the settlement of the soil of high waters and stopped . . . the filth of sundry drains running into it, with several houses of office upon it.

"For prevention of which it is proposed—That the pond reaching up to Sir Robert Pyes be made a receptacle of water at high tides, to be kept in till a low ebb by flood gates at the mill and a sluice at Sir Robert Pyes, which is to be drawn to let forth a source of water so oft as needs require to scower the sewer; that the sewer be made perfect from Sir Robert Pyes to Tuttle-street, by St. James's-parke wall, and cross King-street by the bowling ground at Whitehall, and so into the river of Thames."

The early topography of Westminster can be made out fairly well by such entries as these, especially when they are all before the student ready to be transferred to a map.

Again, in 1692, leave was given by the Westminster Commissioners to Elizabeth Campion, widow of Richard Campion, to continue a sewer formerly belonging to Coventry House (where Coventry Street now stands) for the drainage of thirty-four houses built by her late husband. A year later Richard Rider petitioned for leave to make sewers for his

new houses in Cranbourn Street. In 1705 the Duke of Bedford was allowed to lay the drainage for the houses to be built "on the site of his late mansion-house," and similar leave was granted to the Duke of Argyll in 1735 for the drainage of the new buildings on the ground of his mansion-house in King Street. The petition is also recorded of John James, a builder, for sewers to drain new houses in the neighbourhood of Golden Square, probably the still-existing John Street and James Street. The Earl of Oxford in 1726 laid sewers for his new buildings in Marylebone Fields without leave of the Commissioners, and was promptly summoned. The jury appointed to inquire into matters of drainage reported (1678) that one Richard Frith had erected 257 houses in Soho Fields, and had laid out ground for 300 more, and that consequently the old sewer leading from the fields was liable to be flooded. "We questioned the said Frith whether he had authority to bring his water into the antient sewer, and he could give no account thereof." After due consultation Mr. Frith agreed to continue a sufficient "shore" from his own buildings at Soho down to the "White Horse Inne," and if necessary to contribute to the widening of the sewer in St. Martin's Lane near the "Ladie Seymour's house."

The pages of these minute-books bear frequent references to places which find little or no remembrance in the modern street nomenclature of London. The Cook and Pye Fields, *alias* Marsh Land, were adjacent to the Cook and Pye brew-house, in the parish of St. Giles-in-the-Fields. Mill Field or Kirkham Close is difficult to locate, but was probably west of the present Regent Street, perhaps on the site of Mill Street. The Pest field, where victims of the Great Plague were buried, was to the east of Carnaby Street. It was built upon in 1726. Some of the places mentioned are remembered only in the names of streets. Oliver's Mount Fields, mentioned in a description of the extent of Sir Richard Grosvenor's land, represents the site of one of Cromwell's abortive military forts, and are remembered by Mount Street. A reference to Newport Dead Wall recalls the site of Newport House, on which are Newport Street and Market Stand. Albemarle Ground was the site of Albemarle Street.

A series of presentments of the jury for work required about the sewers under the jurisdiction of the Westminster Commission of Sewers dates from 1668 to 1848; Holborn and Finsbury from 1683 to 1684; Surrey and Kent from 1746 to 1793; and St. Katherine from 1754 to 1821; and give important details in the topography of London, introducing us to the early condition of streets now in existence and to streets that have long since been destroyed. Each entry contains, besides the names of owners of property, the businesses carried on, important descriptions of streets, alleys, and roads. As examples of the entries, the following extracts are given from the presentments and

amercements of the eastern jury of the Surrey and Kent Commission :—

"1. *27th May, 1748*—We find that in the river of Thames opposite to and near Pepper Alley Stairs in the parishes of St. Olave and St. Saviour in Southwark . . . at a small distance from the banks of the said river there is a very great hole . . . and we find that the Mayor and Commonalty and Citizens of the City of London ought to fill up the said hole; we therefore present the Mayor . . . to make good the basement of the Thames bank . . . to be . . . done by 10th June next or forfeit . . . £500.

"3. *6th October, 1757*—We present Taylor Ayres, of the parish of St. Mary Magdalen, Bermondsey . . . to cast, cleanse, scower, and open to its antient wydth and depth the common sewer which runs across his rope-walk, near Cherry Garden-street . . . and the soil to carry away in order to give the water its free and usual current . . . to be . . . done by 2nd January next, or forfeit . . . 10s.

"4. *26th April, 1759*—We present . . . the Earl of Salisbury to repair about 8 rods of wharfing next the common sewer near Mill Pond Bridge at the bottom of West-lane in the parish of St. Mary Magdalen, Bermondsey . . . in order to prevent any rubbish or soil from falling into the said common sewer, and annoying and obstructing the current of the water . . . to be . . . done by 24th June next, or forfeit for every rod then undone . . . 3s. 4d."

An equally important series of documents are the rate-books. The rate-books of the Westminster Commission range from 1695 to 1848; the Tower Hamlets Commission from 1703 to 1847; the Surrey and Kent Commission from 1723 to 1848; the Greenwich Commission from 1775 to 1808; the Holborn and Finsbury Commission from 1779 to 1848; and the Poplar Commission from 1825 to 1845.

The name of the occupier and the rateable value of the premises in each street are set out in addition to the rate levied, and the value of such material as this for the history of London is, of course, very great. It would be difficult to select extracts from the rate-books; but if the streets where practically little or no alteration in structure has taken place could have the valuations at quinquennial periods printed in the same manner as the valuation of St. James's Square has been printed in Mr. Dasent's history of that place, I think the results would prove acceptable to many people. In addition to this, the residences of celebrated persons can be noted and the chief centres of residential or industrial occupation traced out.

The nomenclature of many of the streets outside the city can be restored from these books. Shalligonaked Street appears in the Wapping rate in the year 1748; the Land of Promise, still the name of a Shore-ditch slum, was once the name of a field on the site. Southwark was remarkable for its oddities in the matter of street names. It contained Dirty Lane, Foul Lane, and Harrow Dunghill. Bandy Leg Walk was near the site of the present Great Guildford Street. Sol's Hole was a slum near Holyfield Street. Loving Edward's Lane led from Camberwell to Deptford, and appears in very recent maps. The west end of London had its strange street names, some of them well known by

their mention in old literature. Defoe mentions *Knave's Acre* (now *Little Pulteney Street*), which appears in the rate-books for many years, and is shown in *Rocque's map* in 1746. In the parish of *St. Margaret's, Westminster*, were *Cabbage Lane*, *Powder Beef Court*, *Thieving Lane*, *Adam-a-Digging Yard*, *Codpiece Court*, *Hell* (in the precincts of the former royal palace), and *Petty France*. Some of these are still in existence.

Some curious cases of corruptions in the names of streets may be noticed. Thus, *St. Ermin's Hill*, in *Westminster*, is a typical instance of the way in which the name of a street is altered in process of time. Its present name was doubtless the original one, but in the rate-books for the district it appears variously as *Torman's Hill* (1704), *Dormor's Hill* (1714), *Dorman's Hill*, and *Torment Hill*. The latter is the spelling in *Rocque's map* of 1746. *Horwood's plan* of London, published at the end of the century, reverts to the old correct name which is now always used on modern maps.

The courts and alleys forming the rookeries which have been swept away for successive improvements are all included in the various assessments here recorded. Some were pulled down at the formation of *Regent Street*, others to make room for *Trafalgar Square*, *Victoria Street*, *Whitehall*, the *Strand* improvements, and the new *Law Courts*. The names of many of them are interesting in showing their connection with the old aristocratic houses near which, or on the site of which, they were built. From the lists of inhabitants of streets at successive dates the spread of the town may be traced. At the Restoration the leaders of fashion congregated round *Soho Square*, or *King Square* as it was then called. When the *St. Alban's* estate was built on a few years later, many of the nobility migrated to *St. James's Square* and the neighbourhood. Early in the eighteenth century, *Hanover Square*, *George Street*, *Conduit Street*, etc., were built, and by 1723 many of the nobility had taken the new houses. Later on, *Grosvenor Square* and the adjacent streets became the scene of a fresh migration. Among the inhabitants of these quarters are many famous in history and literature. *Sir Isaac Newton* was rated in *Little Jermyn Street* at £80 a year in 1706. *Dr. John Blow* was assessed at £35 for his house in the sanctuary, *Westminster*, in 1703; *Dr. Cypriannus* for house in *Wells Street* at £16 (1710). *Sir Godfrey Kneller* lived in *Great Queen Street* in 1708; *Mrs. Oldfield* in *Southampton Street* in 1713; and *Grinling Gibbons* on the east side of *Bow Street* in 1718. The assessment for *Villiers Street* in 1725 contains the names of *Philip Arbuthnot* and *Sir Richard Steel*; that of *Charles Street*, *Covent Garden*, shows *Colley Cibber* to have lived on the west side in a house rated at £65 (1731). Later books show the names of *Jacob Tonson*, the bookseller in the *Strand*, assessed at £60; *William Hogarth*, in *Leicester Fields* (£45); *Richard Brinsley Sheridan*, *Michael Rysbrach*, and many others. On

the south side of Brook Street, in 1739, lived George Frederick Handel, rated at £20. His fame was apparently not then universal, for in 1735 he is entered as Frederick Handwell, Esq.

The maps of London may also be illustrated from one other important source, and that is the imprints of early printed books. An examination of the catalogue of early printed books in the British Museum, or of Mr. Hazlitt's 'Collections and Notes,' supply innumerable references to the dwelling-places of printers at different dates, and to get these collated and properly located would restore a seventeenth and eighteenth century London of surpassing interest. The work would be tedious and long, but I think the results would be worth the labour involved. Thus, taking the first twenty pages of Hazlitt's 'Collections and Notes,' we have the following names and centres of the bookselling business:—

Authority	Date.	6. London Bridge	7. Fleet Street	8. Strand.	9. Ludgate Street.	10. Bishopsgate Street.
Hazlitt, i. p. 2	1685	T Passinger				
" " 8	1664	O. Tyus				
" " 12	1690	J. Blase				
" " 2	1669		S. Speed			
" " 6	1595		W. Mattes			
" " 14	1571		Marsh			
" " 4	1660			W. Smith		
" " 18	1720			W. Bray		
" " 4	1678				J. Edwin	
" " 2	1701					J Gwillim

Authority.	Date	11. Charing Cross	12. Smithfield.	13. Little Britain	14. Brittaines Burne.	15. St. Paul's Churchyard.
Hazlitt, i. p. 15		R. Wyer				
" " 16	1619		R Ibbetson			
" " 18				J Audley		
" " 1	1635				W. Sheares	
" " 1	1640					W. Morley
" " 6	1652					G. Calvert
" " 7	1665					R. Loundes
" " 7	1548					R. Jugge
" " 9	1590					E. White
" " 10	1617					Norton
" " 11	1661					J. Latham
" " 14	1686					H. Bon- wicke
" " 14	1551					J. Kyng
" " 17	1661					W. Miller
" " 19	1696					R. Welling- ton

Authority.	Date.	16. Warwick Lane.	17. Cornhill.	18. Chancery Lane.	19. Newgate.	20. Glitapur Street.
Hazlitt, i. p. 5	1698	R. Baldwin				
" " 6	1652		J. Grismond			
" " 10	1658		Farnham			
" " 6	1628			R. Hawkins		
" " 7	1639				T. Vere	
" " 7	1659					Gilbertson

Authority.	Date	21. Poultry.	22. Lombard Street.	23. Westminster Hall.	24. Moorfields.	25. Ivy Lane.
Hazlitt, i. p. 8	1664	Godbid				
" " 9, 18	1588		Hackett			
" " 10	1691		Clark			
" " 10	1673			Hausmann		
" " 10	1671				Smelt	
" " 12	1633					R. Royston

Each of these names represents a quaint description of the house: "Imprinted at London in Fletestrete nere to S. Dunstons Church by Thomas Marshe;" "Imprinted at London by John Charlewood dwelling in Barbican at the signe of the Halfe Eagle and the Key;" and so on.

The same sort of evidence can be collected from old London directories, many of which are of the greatest interest. The earliest are little more than mere lists of merchants. That for 1677, in fact, simply professes to be "A collection of the names of the merchants living in and about the City of London; very usefull and necessary. Carefully collected for the benefit of all dealers that shall have occasion with any of them; directing them at the first sight of their name, to the place of their abode." No numbers are given. The entries take the form of "Mr. Ludlow, Bow Lane," or "Mr. Brabant in St. Swithin's Lane at a Packer's," "Thomas White at the Blew Anchor in Lumbard Street." The first directory containing the numbers of houses is the 'London Directory' for 1778, and Kent's directory for 1799 specifically states that it contains the "names and places of abode of the Directors of companies, persons in public business, merchants, and other traders . . . with the numbers as they are affixed to their houses, agreeable to the late Acts of Parliament." Johnstone's Commercial Guide and Street Directory for 1817 gives a *classification* of trades, etc.

There is one last aspect of London maps which will interest all Londoners. This is the collection of the information which shows the gradual growth of London. The earliest map of this kind known to

me is one which was published by the Royal Commission on water supply in 1869. This map shows extensions from 1560 to 1745, thence to 1818, thence to 1834, thence to 1867, and some few suburban extensions.

A better view of the growth of London, however, is to be obtained from the various Estate Acts, which were passed to enable entailed estates to be let for a term of years on lease. A few months before his all too early death, the late Mr. Charles Harrison, M.P., drew up a map from the great collection of private Estate Acts which he had acquired, and he gave this to me. It shows eight different extensions—from the city walls to 1658, from 1658 to 1668, thence to 1745, thence to 1799, thence to 1832, then the 1832 extension, next from 1832 to 1852, and finally from 1862 to 1887. Thus is shown the ever-widening area creeping along the highways, and gradually filling in until at last the monster city, as it is called, has become one vast extent of bricks and mortar with little, if any, architectural purpose or design, with unlovely houses in unlovely streets—a city spoiled of its natural beauty and delight by the unthinking hands of the modern Englishman.

The first extension is along the river-bank to Westminster on the north and Southwark on the south, showing the river to have been the principal highway of the city. The next extension, just after the Fire, is north of the city area towards Old Street. Three-quarters of a century later (1745) we get a great extension all round up to Hyde Park on the west, just north of Oxford Street, Theobald's Road, and Old Street on the north, to Whitechapel and Limehouse on the east. Another fifty years (1799) we have a further fringe of narrow dimensions penetrating to Knightsbridge on the west, creeping up Edgware Road, taking in the southern part of Marylebone, extending to Camden Town, adding to the 1745 extension in the east a narrow belt all round, and finally showing the first great extension in north Lambeth along the banks of the river. In 1832 the Regent's Park district on the north, a large district of Lambeth on the south, and a further extension of Bermondsey and Southwark are the principal features. Islington, St. Pancras, Shoreditch, Bethnal Green, and Mile End also filled up at this date, together with a little bit of Greenwich. In 1862 the great era of building set in, and all round the boundary of the 1832 limits we have great extensions. The next stage is 1887, which again shows an extension of the building area all round the map; and now twenty years later we have scarcely any boundary of London left, for building has gone on spreading into Kent, Surrey, Middlesex, and Essex at a pace which almost defies the cartographer.

I cannot, however, finish my all-too-imperfect account of the story of London maps on a dismal note. The streets along which we walk are historic spots. Great Englishmen and Englishwomen have trodden them for ages. I do not know whether a map of London appeals to

most people as it appeals to me. It conjures up all sorts of ideas, all sorts of romances, all sorts of desires. To take the map of a given date and walk through the streets it depicts, and to note the remains of the picturesque and the historic, is a delight which only those who have tried to accomplish it can understand. It makes one love strange routes and strange places. I always prefer to go through the crooked and now uninteresting Marylebone Lane to the straight lines of Baker Street and Wigmore Street. I love the courts out of St. James's Street, for through them Samuel Rogers led Fenimore Cooper to the theatre in order to avoid the throng and the mud of the streets. I delight in the narrow streets of the old city, where, on any Sunday, you may see quiet retired nooks containing houses with beautiful doorways and quite magnificent architecture. As an example, there are parallel to each other from Lower Thames Street to Eastcheap and little Tower Street three lanes, St. Mary-at-Hill, Love Lane, and Botolph Lane. They lie close together, a little paved alley, called Church Passage, connecting St. Mary-at-Hill with Love Lane; Botolph Alley leading from the latter into Botolph Lane, where stands the church of St. George, with which is united the Parish of St. Botolph, Billingsgate. In a courtyard that might well escape the passers-by, entered as it was through an archway of the most unassuming appearance, there stood only a short time since, an old and beautiful house. It was placed with its back to Love Lane, while the front looked out on a square paved with cobbles, and surrounded with buildings presumably much more modern than the mansion. The hall occupied the whole depth of the house; it was over 30 feet long, and nearly 20 wide. A double sweep of stone steps led up to the front door, and we could stand on the wide level flagging at the top and look over the iron rails, gazing round the quiet courtyard and peeping down at the big dog-kennel formed by leaving an opening under the steps; and the "dog-lick," hollowed out of solid stone pavement, ran below.* If this is a true description, the destruction of such a house is only a little less scandalous than the destruction of Crosby Hall.

Then there are the closed-in courts at the back of the Strand and in Holborn. These are not only the last relics of places where Samuel Johnson, Oliver Goldsmith, Garrick, Sheridan, and a host of others dwelt or congregated, but they are the still living survivals of old inns, the centres of London life for ages. Not only the side streets, but the backs of houses should receive attention. I always get to the backs of houses in old streets whenever I can, for one comes upon unexpected glimpses of the country aspect of London parishes—long, slanting red-tiled roofs, and buildings of much simple beauty. No one knows how much of old London is still left to us in these out-of-the-way

places. The maps of London will still lead us to them, or what remains of them, if we use the maps properly, and London, under their guidance, will assume some of its past glories, and present to its modern citizens a city to be proud of and to think about, as much on account of its picturesqueness as of its greatness.

Before the paper, the President: It seems hardly necessary to introduce the reader of the paper, as most of you probably live in London—at any rate, for part of the year—and must be very familiar with Mr. Gomme's name at the foot of our countless public notices. For he is the chief permanent official of that County Council—the greatest municipality in the world—under whose watchful care we live and move (in their tramcars) and carry on our avocations in comfort; while the County Council themselves perform their multifarious public work under conditions of discomfort which no other civilized capital would tolerate. But there are signs of a change in that respect, and when the Royal Geographical Society of the next century listens to a paper on London, there may be thrown on the screen a photograph of a County Hall not unworthy of the metropolis of the Empire.

Having necessarily to speak of the County Council in connection with Mr. Gomme, let me first add that we welcome here to-night a number of their members—including chairmen past, present, and future—and that I have received a letter from the very earliest and most famous of their chairmen—Lord Rosebery—explaining that he could not come, as the Prince of Wales is dining with him.

To the great body of the Fellows of our Society scattered over the globe, Mr. Gomme's name is known in a very different connection. We recognize him as one of the chief authorities in this country on folklore, upon which he has written very extensively. I believe that he founded the Folk Lore Society. Moreover, as an expert archaeologist and sociologist, he has produced many valuable contributions on that most interesting and important subject, "Village Communities," as also on Local Institutions generally and the principles of Local Government. I have not yet had the advantage of reading his latest work—published in 1907—on 'The Governance of London;' but I understand that it deals with the various forms of the local governments of London from the earliest times, and that in this work he has maintained and even surpassed the high level of his previous works.

When I first heard that Mr. Gomme might be induced to give us this paper, I hesitated for a moment between a keen recognition of the special interest of the subject and a doubt whether it was strictly geographical, or more fitting for the Historical Society. But that doubt was only momentary. For cartography is the very basis of geography; and we do occasionally indulge at these meetings in the luxury of historical geography. Moreover, we recognize that our science is not only essentially human in its ultimate aims, but that one of its most purely scientific branches deals objectively with the mutual interactions of mankind and their physical environment. The magnitude of London, its influence on the human race, and the way in which both the extent and the mode of its growth and the characteristics of its inhabitants have been determined by its geographical conditions, including of course in these its very peculiar climatic conditions, differentiate the story of its maps from ordinary local topography and local history.

Following the usual practice here, Mr. Gomme will deliver only such portions of his paper as are permitted by the limitations of our time and by the exhibition of explanatory photographs on the screen. His paper will, as usual, be published in full in the *Geographical Journal*. And I have no doubt that this complete paper, even without the advantage of pictorial representation which we to-night shall

enjoy, will be read with exceptional interest in distant parts of the Empire, where it will probably be reproduced in their local magazines and newspapers. For although the majority of our English-speaking brothers in those regions know that they will probably never visit London, they still turn their mental vision with interest and affection towards the historic centre and the living heart of our common country, the British Empire.

After the paper, Mr. PERCY HARRIS: I am glad to have the opportunity of saying two things. First of all, I hope it will not be thought unfit if I thank Mr. Gomme for the very interesting paper he has read, and if I express the opinion that it is a great advantage to London to have, in the chief official of its principal governing body, one who is so interested in and so full of knowledge of the antiquities of London. I think both those who are engaged in the government of London and the inhabitants of London generally do want to take more interest in the antiquities of London, in the many matters of interest which those who walk about can discover in London. I cannot help thinking that if Mr. Gomme would take many of us for a walk through London, we should have a very interesting walk. I cannot venture as an expert to discourse upon London maps, though I hope we may hear some expert remarks from others present. I only desire both to express the pleasure with which I have been here and listened to this lecture by Mr. Gomme, and also our obligations to the Geographical Society for the treat they have afforded us.

Sir JOHN BENN: I am delighted to be associated with my friend Mr. Percy Harris in giving thanks to our clerk, Mr. Gomme, for his admirable lecture. We are very much indebted to the Geographical Society for bringing the London County Council together in this delightful fashion to-night. I am bound to say I have been altogether charmed with this delightful lecture. I do feel that one result of this admirable lecture may be that we may all be more than ever proud of this London of ours. I am not speaking in any party spirit, because it does not apply to this particular instance, but I could not help feeling sincerely sorry the other day when Crosby Hall passed away in such a summary manner. But, anyway, we are here to increase our interest in the story of London, and, I am perfectly sure, to join hands in making it a noble and great city. I commend the study of London to every one, and I am perfectly sure that whatever label we may bear, we are all one in our desire to make our city worthy of this great empire.

Sir HERBERT JEKYLL: I had no idea of saying anything, because, interesting as Mr. Gomme's paper has been, it is related to the past, whereas I might say my interest lies mainly in the future. If Mr. Gomme could have shown us a map of London, say, of 1920, it would have been of surpassing interest, and would have given us some indication of what we might hope to see in the years that lie before us. I do not profess to be an antiquary, or to have any knowledge of these things which Mr. Gomme has spoken to us about, but perhaps the most interesting part of his lecture was that which related to the detailed maps, such as the map which was drawn, he says, by John Evelyn of his estate at Deptford. I can only join in the chorus of approbation for the excellence of Mr. Gomme's paper, and the extreme interest of what he has been good enough to tell us this evening.

Mr. ORDISH: Mr. Gomme has taken us over such a vast area, that in the space of two or three sentences it is impossible to do more than raise one's voice in the general vote of thanks. In the maps of the Elizabethan period which Mr. Gomme has shown us, you may have observed that there was a territorium called Scotland near Charing Cross, and near the Tower one called Wales. Germany was represented in a district called Petit Almaine, or the Steelyard, in Upper Thames Street; there was a Petit France in Westminster, and another in London itself. The numerous Dutch colony assembled for worship in the church of Austin Friars,

which was specially set apart for their use. Indeed, our London of that period, small as it was, in these microcosms of nationalities represented a large part of the map of Europe. On the facade of the Royal Exchange which you saw on one of the slides, built by Gresham, was an inscription in Latin, Dutch, French, and other European languages. Merchants assembled within that bourse were attired in the costume of the countries whence they came, and the confusion of tongues was likened by Dekker, the Elizabethan dramatist, to that of the tower of Babel. Thus it was that the capital was representative and imperial then, in those days of Queen Bess, as it is to-day. Mr. Gomme has shown us the territorium of Roman London, and to all of us present it must have occurred that that territorium is being brought again into touch with the centre by the expansion of London, on the one hand, and by the means of communication which are multiplying in every direction. It will add to the interest of all residents in those outlying districts to realize that at one time that part which has now come near to London was also in Roman times attached to London.

Mr. MACKINDER: Although Mr. Gomme was good enough to send me his paper before the meeting, I am sorry that I was occupied to-day, and had not time to read it, and therefore I am dependent upon what he has said. But I do not think any one can doubt as to the importance of the study to which Mr. Gomme gives himself, and as of course a portion of his audience is very much interested in the rates, it seems to me of some importance to say that there is a practical aspect to what Mr. Gomme has been treating us to this evening. I was much struck with his archaeological habit of going to his work by the by-ways, the Marylebone High Street, and the rest of them. Well, I venture to suggest that it would be an excellent thing for the London County Council, an excellent investment for the ratepayers, if for each of the chief districts of London, five or six, they issue a special set of maps to be hung on the walls of the schools. If you could once imbue a large portion of the young citizens of London with the archaeological enthusiasm, they might in the future follow the narrow ways in going to their business, and so solve the traffic problem for us. But seriously, I cannot help feeling that if Mr. Gomme could induce the Education Committee to do something of this kind, he would be doing a most valuable thing. I believe that the children can be got to take the greatest interest in the names of the streets which they know, and in the curious turns of those streets, to be pieced together so as to reveal various past Londons. It seems to me of real political importance to tincture the minds of the young with the historical sense, which is not to be got by merely learning from a text-book. The slow mending and altering of things over a long period in a given district of London would be a most valuable lesson in practical citizenship, and would appeal to the very concrete imagination of children in a way that a more abstract teaching would not.

With regard to Park Lane, may I note that the Edgeware Road does not lead straight into the lower part of Park Lane. I suspect that in the north-east corner of Hyde Park some other cause than the old village community has been at work. There looks to me something very much like an encroachment on the common land of the community which has given that odd kink in an otherwise Roman straightness of line from the Edgeware Road to Piccadilly, and when I see the agitators on Sunday afternoon take possession of that very corner, I cannot help feeling that a sense of history might possibly give them a power of appealing to facts in the very locality in which they stand.

One other point. The date for the Agas map was given as 1571, but upon that map, on the Royal Arms, is the lion of Scotland. I suppose that the map was reprinted at a later time, but no doubt Mr. Gomme will explain.

Mr. GOMME: I feel that I ought, in the first place, to thank those gentlemen who have joined in the discussion for the unanimous opinion they have been good enough to express on my lecture, but my lecture would not have been possible if it were not for the kindness of the London County Council in exhibiting the maps and the other documents in the tea-room; to the London Topographical Society, whose reproductions of some of these maps have been so very delightful; and to a few kind friends who have helped me with the slides, and lent me some of them—my friend Mr. Ordish, in particular. I should like, also, to record the fact that the council is doing a great deal of good work in the direction that my friend Mr. Mackinder has just pointed out. It is not only publishing its early manuscript records, but it is recording on historical houses the names of those who have made them historical. It is also at the present moment inaugurating a series of lectures by Mr. Vickers on the History of London, so that in these various directions the council is doing all that it can to teach the young citizens something of the city in which they live. I am afraid that my imagination, good as it is, would not enable me to produce the map that Sir Herbert Jekyll is so anxious to obtain, namely, London in twenty years' time. Sir Herbert Jekyll, alluding to Sir John Evelyn and his love of gardening, reminds me that I happen to possess a rather scarce tract by John Evelyn, which advocates the fascinating idea of removing the smoke nuisance of London. It suggests how, in olden times, problems were then much what they are at the present moment. Mr. Ordish, alluding to various localities known as Petit France and other similar names indicating and showing the residence of foreigners, reminds me of a very remarkable passage in one of our old chroniclers, Richard of Devizes, I think, who describes a traveller's journey through England from the various cities, and mentions London as noted for being infested by all sorts of foreigners. I was immensely struck with Mr. Mackinder, a distinguished geographer, suggesting to myself, an undistinguished archaeologist, the necessity for making ancient London better known. I recognize that when a geographer thus speaks, he has realized to the full the practical conditions of such a subject. With reference to the two points that Mr. Mackinder alluded to: as to the connection between Edgeware Road and Park Lane, I feel sure he is right in suggesting there is some twist at the northern end whose history we have lost; and with reference to the Agas map, I must confess for the moment to have made a slip when I dated it 1561. I meant after 1561, when the spire of St. Paul's was destroyed, but containing evidence of details before the date of James I.'s accession. Maps in those days were not done so quickly as Messrs. Stanford do them now, and alterations were not made of changes which had taken place during the compilation of the map. I beg leave to thank the meeting for their attention and consideration.

SWEDISH MAGELLANIAN EXPEDITION, 1907-1909.*

By CARL SCOTTSBERG, D.Sc., Leader of the Expedition.

I. THE FALKLAND ISLANDS.

ACCOMPANIED by Mr. T. Halle, geologist, I arrived at Port Stanley, October 26, 1907, on board a P.S.N.C. steamer. In the early spring we worked in the neighbourhood of the town, where, however, the geology is of little interest, and the appearance of vegetation much changed by

* Dated "Punta Arenas, April 1, 1908."

colonization. Through the kindness of the Falkland Island Co., Ltd., we soon got an opportunity to make a journey round the West Falkland islands, November 18 to December 7, visiting many places, especially the outlying islands, where a naturalist had never been. December 7 to 11 were spent on West Point island, one of the most interesting of the entire group. From here we started to cross the main island in various directions on horseback, in order to get a detailed view of the geographical features and their explanation by the geological history of the place.

After having returned to Port Stanley, we set out for a survey of the great East island. We here met with a most interesting field for our work, through the discovery that the so-called "Lafonia," i.e. the south-western part of the East island, belongs to a different geological formation from the rest, namely, the Permo-Carboniferous period (further notes on this matter are given below). The expedition owes a great deal to the authorities of the colony, His Excellency the Governor taking a keen interest in the survey, and doing everything possible to facilitate our work.

On February 12 the expedition left the Falklands for Punta Arenas, from which an excursion to the unknown interior of Tierra del Fuego has been carried out.

Geology.—On this subject Mr. T. Halle makes the following communication:—

"The Devonian formation, which constitutes the larger part of the islands, was closely surveyed, and fossils discovered in several new localities. The stratigraphical and tectonic conditions, on the West island especially, proved to be of interest.

"My most important task, however, was to solve the question of the supposed occurrence of Permo-Carboniferous beds of the Gondwana type. Some fragmentary plant fossils, collected (1902) during the Swedish Antarctic Expedition, were described by Prof. Nathorst in Stockholm under the name of *Phyllothea*, sp., and compared with a species of *Glossopteris* flora, but because of the poor condition of the samples his determination remained doubtful. I have now been able to settle the question. Fossils, principally leaves of *Glossopteris*, occur in many places, and it is evident that the whole southern part of East Falkland, South of Wickham Heights, belongs to the Gondwana system. At the base of the *Glossopteris* series I discovered a clay containing blocks and apparently of glacial origin, which undoubtedly corresponds to the well-known moraines from other parts of Gondwanaland.

"Of more recent formations, an interesting forest-bed, discovered on West Point island by Mr. A. E. Felton, was made an object of special investigation. The bed, which contains great quantities of large trunks, is covered by old "flowing-soil," and is probably of pre-glacial age. After having been worked out, my collections will give important

information as to the phyto-geographical and climatological conditions during the Early Quaternary. I have also paid attention to the other Pleistocene deposits, as well as to the question of changes of the level supposed to have occurred in the latest period. The result of these researches cannot be communicated until the observations and collections have been thoroughly studied."

Botany.—Our travels around and across the islands have given me a very good view of the general habitas of the vegetation, and the collection of species, many for the first time found on the islands, or even new to science, may be considered as very complete. The different plant-formations have been studied from an ecological point of view. Of special interest was the vegetation on the summits of the mountains; their height is not very great, the highest, Mount Adam, only ascending to 2315 feet; but I was able to prove the occurrence of some elements, characteristic of the Alpine flora of Tierra del Fuego. Special investigations were made into the marine plant-life in order to continue the work I commenced in the Antarctic Expedition, 1902.

Zoology.—In connection with the algalogical studies, specimens of marine animals were secured. Of the terrestrial fauna, I confined the work to the insect life.

II. PRELIMINARY REPORT ON THE SURVEY OF THE NEIGHBOURHOOD OF LAKE CAMI * (LAGO Fagnano), IN TIERRA DEL FUEGO.

The great lake in the interior of Tierra del Fuego, Cami, has awakened the interest of the geographical world, especially through the work carried out by Swedish scientists. With the exception of the Argentine-Chilean commission for fixing the boundary between the two countries, and through which the outlines became known, only the expeditions of O. Nordenskjöld,† in 1895, and J. Gunnar Andersson,‡ in 1902, have made scientific observations of any importance. But the former expedition never succeeded in reaching the lake itself, and the collections of the latter, which visited only a very limited tract of the most easterly part, were all lost in the *Antarctic*. In fact, when we started on our voyage, we had a clear field for all sorts of geographical, geological, and biological work before us.

The expedition consisted, besides the author, of two scientists, Messrs. Quensel and Halle, and two men. We brought two tents, sleeping-bags, cameras, and various other instruments, a folding boat from the Berton Boat Co., in London, provisions for five or six weeks, and, finally, four horses. For the transport from Punta Arenas to the innermost

* I prefer to use this original name, given by the aborigines of the Ona tribe, who live, or at least lived, round the lake, the one generally used being of very recent date.

† 'Trafi Medolandit,' Stockholm, 1898.

‡ 'Antarctic,' part i. Stockholm, 1904. Here the name "Cami" is published on the sketch-map.

part of Admiralty inlet; the Chilean Government, with the greatest liberality, put the small gunboat, the *Huemul*, at our disposition. On February 27 and 28, 1908, we landed our equipment a little to the east of Rio Fontane and north of the mouth of Rio Azopardo, the outlet of Cami.

Without any luggage, and leaving our men behind in the camp, we at once set out to survey a track for our horses in the Azopardo valley. We knew already that the valley is considered almost impassable, and we could easily see that our transport would meet with great difficulties. This partly depends upon the terribly entangled forests, where spiny bushes and a chaotic mass of fallen trees block up the way everywhere; partly upon the condition of the large peat-bogs. Norddenskjöld's experience prevented us from trying to use the river Azopardo for our transports. We camped that night on the shore of Cami, and returned the next day.

Our doubts as to the valley being suitable for horses were confirmed. We took the baggage in two turns, but were able to do only half the distance in this manner: at the first trial each horse was "bogged" nine times on an average, had to be unloaded, and helped in its struggle to get out of the dreadful peat. But our destination was Cami, and the rest of the way we had to carry everything on our backs, a very doubtful pleasure indeed, and rather trying. On March 7, however, we pitched our tents on the shore in a little bay between the rivers Azopardo and Betbeder. It seems perhaps strange that a distance of 10 miles takes such a time to travel, but in this case one must not judge from mere figures. We soon found that at least the west part of the lake, as to details, is incorrect on the maps, and Halle at once started his cartographical work, resulting in a sketch-map of this part in 1:100,000, and a special plan of the surroundings of our station in 1:200,000.

From the station three excursions were made. The purpose of the first was to find the pass that Nordenskjöld from a distance had seen cut through the Cordillera south of Cami, and where he supposed that it would be possible to travel as far as to Acigama (Lago Roca) and Lapataia, a bay in the Beagle channel. On March 10, Quensel and I myself, accompanied by the German Pagels, left the station and climbed the steep mountain south of it. After some work we reached a crest about 3500 feet above sea-level. From this point we had a splendid view of the interior down to the Darwin mountains, and of the elaborate system of "quebradas," partly with glaciers, from which small rivers flow down to Betbeder and Azopardo. But we also discovered that we had been misled by the maps to take a somewhat wrong way, and had to descend to the Betbeder valley, where we camped for the night. The following day we travelled up the valley and found the pass, not far from which we again camped. Immediately Quensel and I ascended the mountain ridge that, on the map of the boundary commission, is called Tierra Valdivieso, to the east of the pass, and soon

got a good view of the country. On the opposite side of the pass lies a beautiful mountain, the highest on the ridge, with apparently inaccessible summits, probably exceeding 5000 feet, and fine glaciers. It received the name Mount Svea. A heavy snowstorm and the approaching darkness soon made us return to our camp. On the 12th we woke up finding our sleeping-bags covered with snow and the landscape shining in a winter aspect. Following our track of the preceding day, we crossed the main ridge, and probably were the first to obtain the view we now had at our feet. From the pass a valley ran to the south-east; this must be the Aicigami valley. We tried in vain to get a glimpse of the lake itself, but a curve was in our way. Winding in infinite turns, a river flows down the valley, called by us Rio Rojas, after the chief of the naval station in Punta Arenas, Admiral F. Rojas, to whom the expedition owes a great deal. In a valley, a branch from the main one, we discovered a small lake with an outlet to Rio Rojas. We returned to our camp through the pass, where a number of small ponds are situated. In the mean time, Pagels, sent out to shoot a guanaco for provisions—what he also did—had climbed a mountain to the west of the Rojas valley, and it appeared that from there he had seen Yendagaia and the Beagle channel. With the aid of bearings and sketches we hope to be able to contribute in some degree to the map of the unknown interior of Tierra del Fuego. We had intended to travel along the west side of the Rojas valley; the next day was foggy, and, our time being very limited, we had to return to our station, which was reached on the 14th.

From Cami, Halle made an excursion to the mountains north of Lago Deseado. He reports the going to be very trying over steep forest-clad mountains. The lake is not very well laid down on the maps. As mentioned above, we brought a canvas boat. After some work near the station, in order to try the boat, which was found excellent, I set out on the 16th with Pagels, following the south shore and making interesting geological and botanical observations. For the evening we landed on a little island, about 17 miles to the east from the west end; we thought it a good starting-point for the soundings. But this proved to be a mistake. For two days we had to wait on our island, the sea running so high that we could not venture a journey in our little nutshell. In the evening of the 18th the weather became calm, and we started our work, returning to the station. The soundings showed that the depth slowly increases towards the east; the greatest depth I got between the island and the north shore was 71 fathoms. There is a report of "150 fathoms, no bottom," in the middle of the lake. Next summer I intend to try some soundings in the east part.

We returned to the station early on the 19th, and Halle came back the same day. Having finished the work in the Azopardo valley, we moved to our first camp at Admiralty inlet, under very unfavourable

circumstances; rain every day had made the peat-bogs worse than ever, and all the little brooks had grown to rushing streams, forming a serious obstacle.

On the 26th, the *Huemul* arrived, and two days after we were back in Punta Arenas.

Of the special scientific researches I can only communicate the following:—

Geology.—Mr. Quensel's studies of the rocks in Mount Hope, and the mountains to the north and south of the lake, will probably permit a parallelization of the Fuegian with the Patagonian cordillera. Of special interest is his discovery of the lakkolitic nature of Mount Svea—the rock forms a new link in the series of volcanic rocks which play such an important part in the east Cordilleras.

Through Quensel's observations in Admiralty inlet and the Azopardo valley, and my own round the shores of Cami, we have come to the following opinion as to the geographical development of the valley:—Admiralty inlet—Azopardo—Cami, to which system also belongs a valley north of Mount Hope, ending in Admiralty inlet and Cami. At a late epoch of the glacial age the ice-divide lay across the Azopardo valley; one stream ran to the west to Admiralty inlet, another to the east, in the Cami valley. It seems probable that the lakes were dammed up at the east end, where it then ought to have had an outlet to the Atlantic coast; anyhow, it is certain that its present westerly outlet, the river Azopardo, dates from a very late or even post-glacial time; this was proved by Quensel's survey of the river-bed. For a more positive opinion further observations are necessary.

Botany.—The land round the west end of Cami is of great phyto-geographical interest. Here we have to look for the limit between the two types of forests: the evergreen and the deciduous.* During my boat journey I fixed the place where the latter type takes the place of the former. On the detailed studies I cannot enter here.

I got many good opportunities to study the Alpine flora, of which we knew little before.

Zoology.—Concerning the zoological results I can but say that dredge and net probably brought up some interesting creatures from the lake.

A PICTURE OF JAN MAYEN IN 1639.

By Sir MARTIN CONWAY.

At the sale of some of the Duke of Sutherland's pictures the other day at Christie's there appeared an interesting early Arctic painting, which

* See my paper in this *Journal*, 1904.



• THE DUTCH WHALF FISHERIES AT JAN MAYEN ISLAND.

was acquired by the Amsterdam Museum. It now hangs in that gallery. It was signed "C. D. Man," and dated 1689. It depicts the Dutch whale cookeries on Jan Mayen island in full activity. The scene is laid on the shore of the bay where the principal Dutch whaling centre was situated, and it is no doubt the Amsterdam workmen who are represented. In the background on the left the snowy peak of Beerenberg rises with exaggerated abruptness. The middle distance is occupied by ships and by whale-boats pursuing their prey. In front is a cookery in full work, with a dead whale drawn up close by being flensed. The cookery is equipped with two elaborate and well-contrived furnaces to boil the blubber in the coppers. There are two tiers of tables on each side, where rows of men are engaged cutting the blubber small and shovelling it into tanks, whence the coppers are fed. The structural parts of the furnaces are built of red-brick, and have been plastered, but the plaster is already peeling off. Men carry big lumps of blubber on hand-barrows from the whale to the tables. Quite in the foreground are the principal men of the expedition, doubtless portraits. A little way behind, on the right, are the cooperages and other huts. On the left, too, are the great capstans by which the whales were hauled ashore. In fact, we here have a complete representation, excellently painted, of an Arctic cookery, such as we find described as existing in even more considerable development about this time at Spitsbergen, and especially at Smeerenburg. There seems to be no doubt of the genuineness of the signature, so that the painter must have been Cornelis de Man. If so, he was only eighteen years of age when he visited Jan Mayen and made this picture, for it was evidently painted on the spot, or from studies made by the artist himself on the spot. Dutch artists in those days were remarkably precocious. There is no sign of immaturity about this work. De Man is recorded as "having a strong inclination for travel." There is no known record of a visit by him to the Arctic regions. He spent nine years wandering about Europe. He is chiefly known as a painter of portraits and interiors, though doubtless many of his pictures exist under the names of other artists.

THE CLIMATOLOGY OF WEST TURKESTAN.*

By W. R. RICKMERS.

OF a highly specialized, statistical, and mathematical science like meteorology, the geographer can only appreciate the general results. These do not begin to arrive

* 'Zur Meteorologie von West-Turkestan.' Heinz von Ficker. Wien, 1907.
'Denkschs. d. Mathem.-Naturw. Kl. d. K. A. d. Wiss,' vol. 81, 35 pp., 1 Map.

until mapping and colonization have reached an advanced stage. Up till then the climate of the country is described in the terms of its effect upon the morphological, botanical, and economical features of the district. The conditions of surface and life are the standard of comparison, fitfully interspersed with the straggling figures of a few explorers or enthusiastic amateurs. Meanwhile the staid meteorologist has been quietly at work—that is to say, he has been founding stations, and is patiently awaiting his day. Herr von Ficker's work heralds the coming of such a day for Russian Turkestan. Every one interested in Middle Asia will study these thirty-five pages with that eagerness with which one looks forward to a confirmation and exact expression of those facts so far combined or guessed at in a general way. Here at last are the absolute figures, and their meaning and importance are made clear to everybody by the author's lucid explanations. He has found his materials in the reports of the Russian Meteorological Service, which is one of the best organized in the world, some say the best, which I can well believe. Such raw material, the accumulation of a decade of station work, requires a skilful hand to sift and reduce it, and to finally offer it to us in the shape of intelligible reading matter. Only a trained meteorologist can digest the long rows of observations, and if this man is a practical mountaineer and traveller who has already won his spurs in Alpine meteorology, so much the better. Ficker's is the first scientific epitome of Central Asian climate, founded on long series of official records. "Scientific" means "reduced to standard measures," and an example will show this. Travellers who knew something about mountains in a general way had been struck by the scarcity of snow on the High Pamirs. But when now we are told that at Pamirski Post, at a height of 3610 metres, the yearly mean of precipitation is 62.3 mm. ($2\frac{1}{2}$ inches), we can make exact comparisons with other places, and then only do we grasp the full significance of figures. Then we learn that Pamirski Post is not only extraordinarily dry as a mountain locality, but even drier than the desert round Lake Aral; in fact, that it is the driest place in the Duab of Turkestan. The average heaviest rainfall day* in Tirol, for instance, is about 60 mm., or equal to the yearly average of the Pamir precipitation.

The work under review is full of such revelations. The area corresponds to what I have tentatively called the Duab of Turkestan, the land between the two rivers Amu and Syr (Sogdiana). Only two stations make an exception, Narynsk and Prshevalsk, which have been included by way of contrast to show the transition to the Tianshan. The total number of stations is seventeen, and the material obtained from them covers (with trifling exceptions) a period of ten years. Grouping them according to their general nature, eight districts are obtained, such as the northern steppes (Kasalinsk, etc.); the western ruin of the mountains or region of highest cultivation (Samarkand, Jisak, etc.); the high Pamirs, etc. We are introduced to over thirty tables, the result of long and tedious calculations, and representing the quintessence of one hundred and seventy "station-years." From these tables, and a study of geographical literature, the author draws his conclusions, discussing at length the various conditions of temperature, moisture, precipitation, clouds, and winds. In this way he gives us a very clear idea of a very complicated problem. It is impossible here to do justice to so concentrated a treatise, where almost every line teems with new interest. Let us pick out a few facts at random. Kasalinsk (63 metres above sea) has a colder winter than Irkeshtam (2850 metres). Narynsk is extremely cold in winter, only Pamirski Post being slightly colder during January and February, although 1600 metres higher. The contrast between the Pamirs and a place of similar height

* I.e. the mean from the maximum days of many years.

in the Alps is enormous. Pamirski Post represents the climate of the steppes at 3600 metres in the same way as Kasalinsk at 63 metres. The highest mean of absolute yearly extremes is at Pamirski Post, $67^{\circ}4$; the lowest at Prshevalsk, $45^{\circ}1$.

One of the most striking phenomena is the ratio of decrease of temperature with increase of height, which is almost unique. Khorog and Samarkand, though vertically separated by 1400 metres, are nearly equally warm in summer, which condition is expressed by a gradient of only $0^{\circ}35$. Comparing Khorog to the very hot Kerki (245 metres) the mean gradient is still only $0^{\circ}44$. The low steppe at Petro-Alexandrovsk (85 metres) and the high steppe of Pamirski Post (3640 metres) are again brought into close relationship. The differences between their monthly gradients are very small, and the yearly rise and fall—so marked between any other two stations—is almost entirely effaced. It is to its character as a steppe, not to its height, that the High Pamir owes its climate.

The chapters on moisture and rain will be closely scrutinized by all who are asking questions about the past and future state of Turkestan. An absolute monthly minimum is attained at Kerki in August and September (no precipitation at all); but the driest years are at Pamirski Post (62.3 mm.), Petro-Alexandrovsk (67.1 mm.), and Kasalinsk (122 mm.). The wettest month is March at Djisak (84.4); the wettest year at Prshevalsk (452.8). At Pamirski Post the maximum of water falls in June (15.4) and the minimum in March (1.6), while October, November, and December show an even supply of 2.5, 2.1, 2.1. April, the wettest month at Kasalinsk (16), runs the Pamir June pretty close, but June is the driest at Kasalinsk.

There is practically no snow in the Pamirs during winter, but the traveller descending through the valleys of the border mountains finds himself overwhelmed by huge quantities of snow.

The longest periods of drought observed at different places were at follows: at Kasalinsk, three months; Kerki, six months; Tashkent, four months; Samarkand, five months; Pamirski Post, three months, etc.

The able *résumé* on the climate of the Duab of Turkestan would have to be quoted in *extenso* up to the bitter end, which speaks of the hopeless future of a dying land.

The author is to be congratulated upon so happy a choice of subject, no less than on his masterly treatment of it, which has given us a standard work of reference that no student of Central Asia can afford to neglect.

THROUGH EASTERN TIBET AND KAM.*

By Captain P. K. KOZLOFF.

On returning to our camp, we found it literally besieged with natives—men, women, and children from all parts. The Tibetans were enormously interested in all our European things, especially the electric battery, which they regarded as miraculous. Later in the day we were honoured by a visit from the camp chief-tain's corpulent old wife, who came under an umbrella, bringing with her a nice-looking daughter. The latter was dressed in a red woollen dressing-gown, and had

* Continued from p. 534. The map on p. 651 should be substituted for that given in the first instalment of the paper; the former was only provisional, the latter is based on the materials which have been definitely worked out.

not neglected to add artificial colour to her unpolished sun-burned cheeks. Several other Tibetan girls were also there, all dressed in their best, and all of them behaving in the boldest manner. The chieftain's wife and these giddy wenches smiled continually, she encouraging them openly to approach us. The women and girls were quite fearless in looking into our tents. They literally besieged us, and Kaznakoff had, in consequence, no difficulty in taking some good photographs of them. We were told that the morals of the people in those parts are very slack, and that women are extremely free, especially with regard to the Chinese officials when passing through from Sining Fu, to whom even the parents themselves bring their daughters. When my young grenadiers and cossacks sang Russian airs to the concertina, the Tibetans were wildly delighted, and tried to imitate the "little Russians." Then, at a hint from the chieftain's corpulent spouse, the local beauties began to sing. Their songs and style of singing were no different to those ordinarily in vogue in Central Asia, but their songs were full of flattery and gratitude for our generosity.

In the evening the chieftain Namtso-Purzek-Namchje* returned from his travels. He was a tall old man of some seventy-seven summers, grey-haired, and bent. I should mention that Purzek, as the Tibetans call him, is not officially the "bey-khu," though he has had complete control of the camp for many years, as, when scarcely out of his boyhood, he gained the love and respect of his clan by his exploits when fighting N'goloks and other Tibetans. We were surprised that letters and papers, given to us in Sining Fu, were addressed to him by name as the official "bey-khu," as if the real or hereditary chieftain was in no wise recognized. He talked fluently, but was reserved before the large assembly, and we were favourably impressed with him. As gifts he brought me the fox and usual offerings, apologizing, as his son had done, for not meeting us at the boundary of his camp. "It is my fault," said the old man. "When my son was in Sining Fu, the 'tsin-tsai' personally told him that you were to be shown every possible kindness if you came to our country. I will do my best to help you on your onward path." He remained with us for two or three hours, replying willingly to my inquiries as to the best place for crossing the Blue river, telling me about the country and the people living further to the south, etc. He expressed a wish to be shown our new rifles, and to see the escort fire a volley with them. We gratified both his desires, and he and his subordinates were greatly impressed. Before he departed I gave him a revolver, which delighted him enormously.

On the day after Purzek's visit, I and my companions went to return his call, hoping to have another chance of questioning him on various points. The entertainment was again repeated, after which I asked him to allow us to take a photograph of himself and family, and to show us his troops on parade. He refused my first request, but without a moment's hesitation consented to the second, remarking at the same time that the short notice would unfortunately prevent him from being able to collect many of his men. When talking of military matters, the old man seemed to come to life again and to grow young: his dark piercing eyes flashed with fire, his figure straightened, and his energy was remarkable when recalling to his mind forays of olden days.

The evening before we left to continue our onward march, the promised review was held. A number of horsemen assembled at the appointed hour on the level ground close to our camp, whence we were most interested in watching them

* Rockhill, in his 'Land of the Lamas,' pp. 182-185, calls him "Namtso Purdung." Purzek, when talking to me, explained that he remembered Rockhill in 1889, although he did not mention his name.

T S A I D A M

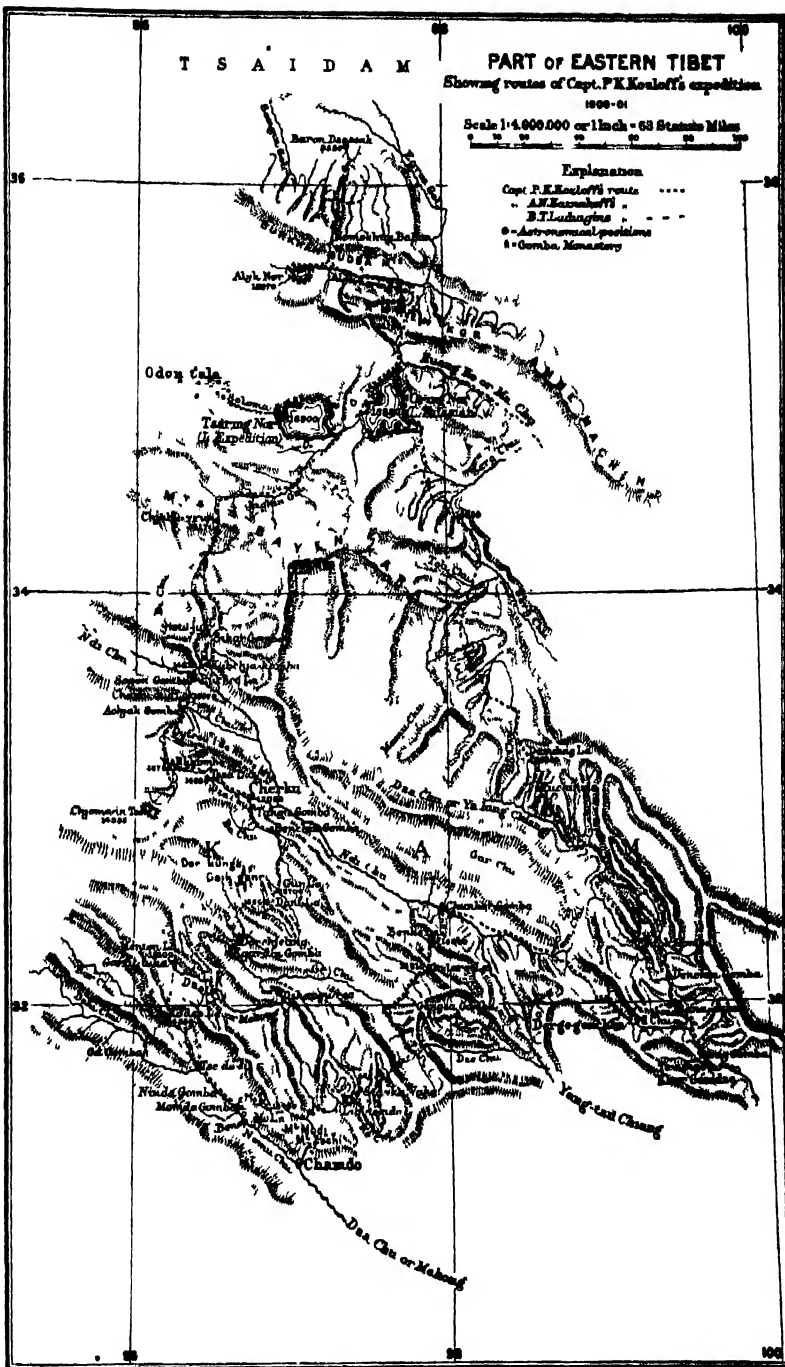
PART OF EASTERN TIBET

Showing routes of Capt. P.K. Kouloff's expedition
1900-01

Scale 1:4,000,000 or 1 inch = 63 Statute Miles

Explanation

- Capt. P.K. Kouloff's route
- A.N. Kozlov's
- B.I. Luching's
- Astronomical positions
- Gompa, Monastery



practising their feats of arms and trick-riding on the way to the parade-ground. At first they cantered along, every now and then taking a jump. Then they increased the pace, and finally, with loud yells, they broke into a gallop and went at full speed. Purzek's eldest son, his assistant, and two twelve-year-old lads, all in their best clothes and on their best ponies, passed the camp bearing themselves right well. The old chieftain, who all this time was in our camp, at length invited us to accompany him to the parade-ground, where were collected twenty-five mounted Tibetans, who from time to time let off a shot as if to show their impatience. In ten minutes we had reached the ground. The faces of the riders showed excitement, and their ponies were equally restless, snorting, rearing, pawing the ground, and anxiously looking around. We were first shown a duel between two men. One of the horsemen having ridden out some 30 or 40 paces in front of the remainder to represent an enemy, on the signal "to commence," galloped off as hard as he could. He was at once pursued by one of the others, who unslung his clumsy flint gun very smartly while at full gallop and fired at him. When they had gone some 300 or 400 paces, both riders turned back in our direction and rehearsed in the same manner. This time, however, they reversed places, the attacker being pursued and doing all he could to avoid the enemy's bullet by leaning down on whichever side of his pony seemed to offer the greatest safety. Several of the Tibetan warriors were exceedingly good horsemen, and performed excellent feats, especially the heir-apparent, who was the first to perform, and who constantly brushed the ground with his cap while going at a gallop. He performed more often than the others. Sometimes he took two rifles, firing them both off as before; and he always did various manual exercises with them previously. During each performance the remaining Tibetans shouted, the old chieftain always taking the lead, especially when his own son was in the arena. Afterwards eight of the men galloped out, four of them going on ahead again to represent the enemy. This was considerably more interesting, both parties firing going out as well as coming in. The full dress, the long hair hanging over their shoulders, and their ugly features were very effective. In a way, this Tibetan review vividly recalled to my mind the onslaughts of the brigand N'goloks on the two occasions when they attacked the late M. Prjevalsky's expedition.

Afterwards we saw some independent and volley firing; but the shooting was bad, in spite of the employment of a huge heavy gun, which took three or four times the ordinary charge of powder. This gun, weighing about a pood, was made locally out of an enormous gun-barrel, which was accidentally found on a hill close by. For long Purzek and his subordinates had endeavoured in vain to ascertain whence this weapon had come and who had been the owner. Needless to say, this rarity belongs to the "bey-khu," and is only used at home for defensive purposes. Having returned to camp with Purzek and his sons, we began to prepare for our onward journey. Our guests remained with us a considerable time, and the old man, dropping his reserve, drank a fair quantity of alcohol, with the result that he became both comical and entertaining. But in spite of it, our memories of him and his camp are of the kindest. He was the first in Tibet to give us a hearty welcome, and he was of the greatest assistance to us on our further journey, providing excellent guides as well as letters to friendly chiefs. By playing upon his reputation of being a sagacious and sensible man—a reputation which reached far beyond the boundaries of his camp—he prevailed upon others, through whose country we were to pass, to assist us.

On July 19, having parted with him, we moved off down the river Khi-chu at the usual early hour. The nullah soon narrowed, bending towards the east, and here at the foot of the cliff we came upon a hot spring, the waters of which are

drunk by the local people for many ailments, but particularly for rheumatism. The temperature of the spring, surrounded by stone walls, goes up to 42°. A little lower down the river, opposite to the spot where the waters fall rapidly over the boulders and are narrowed by the rocky banks, towers the sacred mountain of Hatu-ju,* covered with the eternal snow which glistens in the sunlight. On the banks of the river just under the mountain is the monastery of Sikar-gomba, whose priests, like those of many another which we came across in eastern Tibet, jealously refused to receive a call from us. There are some three hundred lamas in this monastery, and the Gégéns, Chjiku, and Tsema, of whom the former and elder has been reincarnated. According to Purzek, this monastery is very old and wealthy, and is chiefly composed of monks from his own camp. Having temporarily left the stream, we climbed a spur, which we crossed by the Sadi-lakha pass, about 1000 feet above the river, gaining from here a glorious view in all directions. The whole expanse, as far as the eye could reach, was mountainous, and we could see the peaks of the southern prolongation of the Hatu-ju, intermingling as they met the rocky chain adjacent to the Blue river. Descending by a very steep path from the pass, we again reached the Kbi-chu, where lower still, as it broadened out, we saw the greyish-yellow clay buildings of the agricultural population. This was to the south. It was worth looking back again to see the Hatu-ju, with its cones, domes, and tongue-shaped ridges standing out in relief, and the white patches of eternal snow. All around us grew handsome grasses, at first among shrubs, then lower down among trees (*Juniperus pseudo-sabina*). On the way to the village of Kabchja-Kamba we passed a second narrow gorge through the cliffs, where in a schisty cave on the left bank of the stream was supposed to dwell an earthly spirit, who lived in perpetual fear of a water-spirit inhabiting a similar cave on the opposite bank of the stream. Passing these haunts of spirits, we soon came to the dwellings of the Tibetans themselves, close to which we pitched our camp. The sun was warm, and the mild summer breeze prettily rocked the golden barley, above which martins darted to and fro and swallows flitted. The nullahs adjacent to the lower reaches of this turbulent stream enriched our herbarium with more than a hundred specimens. In the upper part of the hills we found, besides those plants which have already been mentioned as growing in the upper Hoang Ho, the following: a very sweet-smelling stellaria, pink androsace, anemone, violet (*viola*) with seeds, euphorbia, chrysanthemum, pedicularis, gentiana, and others. Lower down shrubs were plentiful—willow, caragana, honeysuckle, and spiraea. And of herbaceous plants were quantities of iris, *Isopyrum grandiflorum*, *hippocrepis*, large *parnassia*, onion (*Allium*), tall, handsome pedicularis with purple-coloured flowers, and two sorts of aspidium.

As regards the lower part, it might be divided roughly into two parts—upper and lower boundaries of cultivated land. As we descended into the cultivated area we were struck by the size of the grasses and their shape. About the ploughed fields were umbellar, two sorts of saussurea, blue-bell (*Campanula*), very handsome yellow pedicularis growing thickly on the small damp patches of grass on the banks of the stream, cusinia, cumin (*Carum*), green pease (*Vicia*), *Brassica rheum*, gallium, *Malva borealis*, polygonum, and euphorbia. Near the same ploughed land, by the more or less steep slopes, were quantities of barberry, currant, and gooseberry bushes with large berries, and amongst them were withered-up old junipers. Among these berry bushes flowered geranium with lilac and white petals, a wonderful blue forget-me-not (*Myosotis*), and a very sharp stinging Himalayan

* This is the name by which it is known to the local inhabitants; in far distant localities it is called the Amne-tsokohin-donra.

nettle (*Urtica hyperborea*). The thick stalks of bright green cucumbers and atropa covered the open spaces, rubbish-heaps, old dwellings, and foundations of houses, so thickly that it was difficult to walk. Stone walls separating the path from the ploughed fields were overgrown with the above-mentioned currant and gooseberry bushes, whose roots went down through narrow chinks between the stones some 2 or 3 feet into the soil. Quantities of weeds could be seen growing among the barley, and in lesser quantities were thlaspi, erysimum, carum, pedicularis, blue and green aconitum, myosotis, geranium, aster, lactuca, brassica, boraginea, and two kinds of gentiana. Between the fields we found sedum, valeriana, gymnadenia, gnaphalium, sau-surea, euphorbia, and about six different herbs.

The hamlet of Kachja-Kamba consists of small houses of stone and clay, built in the form of a square. Above these hovels rises a large new house belonging to Purzek, which is built of rounded pebbles, and is as good as one could require. In case of emergency, the besieged inhabitants of the village could make a stand in it, and, taking cover behind the small walls which surround it on all sides, could easily defend themselves from an enemy. We were received in the village by Purzek's sons, who had preceded us or purpose to make the necessary arrangements for our passing through, and a large number of supplies were provided for us. Two brothers of the guides, who had been recommended by Purzek to accompany us to Chjerku, also put in an appearance. Tibetan guides seldom consent to go alone, except in the district of their own camp. In districts belonging to neighbouring or distant communities they will never move with a party of less than two. This is so even with men who know how to protect themselves.

Bidding farewell to the sons of "bey-khu," we left the pleasant Khi-chu nullah, as the road to the ferry across the Blue river inclined south-west, cutting across a high precipitous range of hills. From the steep Pucheg-la pass, 14,810 feet above the sea, we could only see a portion of the narrow blue valley. The river itself at the foot of the cliff was not visible, though the noise of the rocking waters could be distinctly heard with a favourable breeze. The mountain peaks bounding the river on the south block out the horizon. By mid-day we were on the left bank of the Yan-tsui-tayan river, called by the Tibetan of these parts, the N'dui-chu. The current was extremely strong, as the river flowed in its stony, capricious, winding bed. Shortly afterwards we crossed it, being ferried over in a couple of boats which were fastened together at their stern. This ferry is in frequent use. The charge for a man or an animal, a sheep or calf, etc., is about fifteen kopecks in Russian coinage. A third of this is given by the ferrymen to the camp chieftain, while the remainder, two-thirds, they keep for themselves. As we gradually got the baggage and sheep across—the bulls and ponies having to swim—we pitched our camp on a raised terrace on the right bank close to a small, poor-looking monastery (Sogon-gomba). The latter, though not well known, is fairly old. In it are only thirty lamas men and women, and one reincarnation, Durku-rimbuchi, Sogon-gomba has a very good reputation as regards the purity of its morals, although the monastery contains both sexes. The nuns cut their hair short like the men. The Gégén declined to make our acquaintance, although his companions frequently came into our camp. To the south of the monastery on a high hill was a clean, trim-looking chapel, beside which the yellow-hatted lamas can be seen sitting or wandering about. At a short distance from the monastery, and on the other side of a mountain stream, is a village, out of which rises a tower which was once inhabited, but is now empty.

Close to the ferry the N'dui-chu river flows from north-west to south-east, corresponding to the trend of the hilly chain, which encloses it between its rocky feet. The breadth varies from 50 to 60 sajens, with a depth of from

3 to 4 sajens. The water is highest in June. At this time, i.e. July—a month later—it was a sajen and a half lower. In late autumn the blue colour of its waters fully justify the name given to it by the French. In summer the water is a dirty yellow. The temperature was 13°. According to the local inhabitants, the river freezes over in October and is open again in March. The height by the ferry was 12,610 feet, and we were able astronomically to fix its latitude. All along the upper part of the Blue river the Tibetans exploit gold, though not quite in accord with the superstitious belief taught them by the lamas. The shores of the Blue river in the N'ruchu district or near the ferry were no less attractive than the lowly reaches of the Khi-chu. The pretty valley and the adjacent deep nullahs running into it on either side were thickly covered with shrubs. Besides barberry, gooseberry, and currant bushes, hawthorn, spirææ, and honeysuckle, we found bog-myrtle, whose bushes grew to a height of almost 14 feet, with a diameter of 7 inches at the root of the stem. There was also a forest of juniper* covering the slope of the right bank. Fields of barley, grown in terraces along the valley, thrived, and there were quantities of meadow grass. We added the following plants to the herbarium from the sacred Khi-chu: Handsome *Astragalus tinacetum*, bluebell, tall graceful rhubarb, lilac gentiana, orchis, avena, and various grasses; on the sandy shore of the river, salt-wort, blue onion, scorzonera, small-petalled erigeron, and saussurea with sweet-smelling lilac flowers; and on the higher ground amidst the clematis, orobanche, euphorbia, polygonum, convolvulus, plantago, astragalus, and a small-petalled geranium. In the wood of juniper bushes it was not difficult to distinguish lactuca, blue veronica, two sorts of onion, and several others.

As regards animals in the part of the valley through which we passed, there were few of either mammals or birds. Among the latter, besides large and small birds of prey, were the following: Jackdaw (*Coleus dauricus*), hoopoe (*Upupa epops*), jay (*Podiceps humilis*), blackbird (*Merula kessleri*), cuckoo (*Cuculus canorus*), red-tail (*Ruticilla rufiventris*), *Pratincola maura*, *Accentor fulvescens*, finches, *Carpodacus rubicilloides*, *Montifringilla alpicola*, *Pyrgilauda ruficollis*, hawfinch (*Mycerobas carneipes*), swallows (*Chelidon urbica*), *Hirundo alpestris*, *Cotile riparia*, martin (*Cypselus apus*), linnet (*Linota brevirostris*), wild sparrow (*Petronia petronia*), *Abrornis affinis*, white and yellow *Motacilla*, *Budytes citreola*, wild pigeon (*Columba rupestris*), and some others. Very few butterflies or beetles were to be seen, but we hoped to come across some interesting mollusk specimens later on.

From here we climbed a yet steeper and higher range of hills to the south ere again descending into cultivation in the valley of the I-chu, a tributary of the Blue river on the right bank. To assist our transport animals, Purzek had made arrangements for fifteen bull-yaks to be given us, and we in consequence crossed the Chamu-dug-la pass fairly easily: it is 16,070 feet high. Nevertheless, during the ascent up the slope of the narrow and rugged nullah, composed of granite and gneiss, we lost one of our loads, which fell off, and rolling down was broken into many pieces. Fortunately, it was not part of our collection. From the pass, which is somewhat lower than the rocky, slaty peaks of the range, we could see towards the south a deep precipice, at the bottom of which winds the narrow, glittering, snake-like river I-chu. And beyond, the view of the distant horizon is obstructed by the rugged lofty mountains of the Nierchi and another range of hills further away, and nameless, composed of some red rock. In the nullahs through which we

* The trees of which grow to as much as 70 feet in height, with a width at the root of 20 inches.

passed grew a straw-coloured primula, labiate with light lilac petals, three kinds of gentian, a handsome blue aconitum, corydalis, pyrola, and on the pass itself a curious saussurea, another primula, and a large petalled delphinium.

Having descended a short distance on the southern slope of the hill, it repaid one to look to the left, or the east, in order to see two monasteries prettily and snugly situated on the tops of two hills, which fell away sharply on either side. The nearer monastery, called Bagu-gomba, contains about 200 lamas of the Gélupa sect (that is, yellow lamas), with a Gégén called Guchi as its principal. The other and the smaller—Lanchin-gomba—has only twenty red monks of the Nyimapa sect, at the head of which is the reincarnated Tartse-jaola. After entering the valley of the I-chu and proceeding some versts up it, we reached Achjak-gomba, the third monastery on this river, with twenty white lamas of the Karmara sect.* While we were camped here these brethren were away collecting alms for the monastery, so we were, unfortunately, unable to see any of them. At the foot of the little hill which gave a refuge to this monastery stretched a grove of tall willow trees, which grew at regular intervals some distance apart. Between them, and none the less pleasant to look upon, was a green carpet of grassy vegetation, which pointed to being an ideal spot for us to camp. Lower down along the banks of the river were fields of barley bounded by canals and stone walls and by a hedgerow of gooseberry, currant, and barberry bushes, alternating with honeysuckle, intertwined with clematis and *Lasiagrostis splendens*.

On the next day's march the expedition reached the Nierchi mountains, which is the western extremity of a separate mountain group. I named it after that far-famed geographical traveller in Central Asia, Dutreuil de Rhins, who met his death through the savageness of the Tibetans in one of the eastern hills. The characteristic rocks of the Dutreuil-de-Rhins mountains—Nierchi—are composed of light grey quartz sandstone, and of grey and very small-grained limestone. Further eastwards along the foot of the hills on the southern side, we found pieces of hornblended granite, dark grey fine schistous filite, a few sorts of limestone, light grey slate, gneiss, hard brown-pink marl, brown-red conglomerate of small pieces of crystal schist, and clayey sandstone. The small I-chu stream is about 120 versts long. High up and in the centre its course lay right along our road, but lower down it flowed to the left. The Dutreuil-de-Rhins mountains compel the stream to flow in a curious semicircle, at first in a south-westerly and afterwards in a south-easterly direction. The R'khombo-tso lake, whence it rises, lies in an upland plateau which has the appearance of a lovely meadowy steppe, inhabited by nomads.

The I-chu valley enabled us to add the following specimens to our collection: Large-petalled tanacetum, several astragalus, handsome gentiana, two kinds of bracken, a new species of orobanche, Dame's violet (*Hesperis*), two or three saussurea, and a number of grasses, including feather grass. By the lake itself, which is situated at a height of 13,730 feet, we quite unexpectedly came across the common utricularia and reed-grass. By the rocks at the foot of the hills, which are washed by the silvery clear waters of the I-chu, we came across woodcock (*Ibidorhyncha Struthersii*), *Cinclus Kashmiriensis*; mountain finches, *Pyrgilanda ruficollis*, *Pyrrhopiza longirostris*, *Carpodacus rubicilloides*, the former martins and swallows, to which were added a new hill species, *Biblis rupestris*. There was also their handsome relative the redstart (*Chamarrhornis leucocephala*), the first of which are found either by the water or high up amongst the overhanging rocks, and these added a touch of life to our pretty camping-ground. At times from our tents we

* According to Rockhill ('Land of the Lamas,' p. 217, note), the Chinese call the lamas of the Karmara sect "white" lamas.

heard the monotonous cooing of wild pigeons, and against the blue background of the heavens floated the unalterable snow-vulture, the lammergeyer, and the golden eagle. As regards mammals, we secured specimens of the Alpine polecat (*Mustella*), a small colony of which were at the foot of the rocks.

During the daytime none of the local inhabitants attempted to pass our camp, which was pitched in a gorge of the Dutreuil-de-Rhins mountains, but at night we were aroused by the noisy tramping of ponies ridden by Namtso brigands, who were hastening to pass through unnoticed. Our guides contrived to exchange a few words with them, and in the morning they told us that this was a party of young bloods who had made a successful raid upon the possessions of the Nanchins, and who were now making their way home as fast as possible, doing by night as much as 70 to 80 versts, and by day resting and concealing themselves in unostentatious places. We were not a little astonished at the pluck evinced by these brigand Tibetans, considering the awful darkness, especially in the deep and stony nullahs. Our march through the valley of the river I-chu was not difficult, and it was made easier by the chieftain of the Aiun encampment, who supplied us with transport, and for some days accompanied our caravan in person. This chieftain, or "bey-khu," who made his appearance in our camp at Achjak-gomba, looked, in spite of his sixty-three years, a healthy, well-set-up man, while his great height and athletic figure, together with his abrupt manners, spoke still more in his favour. At our first meeting this original old man asked for some Russian vodka, at the same time remarking, "I don't want anything else, but I shall be delighted to drink some vodka, as yesterday at some friends' we had a feast, and I have a bad head to-day." He, however, drank the vodka very cautiously, having previously given it to his attendants to taste. When we became better acquainted with him, we found that he really wished to assist us as much as he could, and to follow the example of his respected friend Purzek. "On us," said the "bey-khu," turning to his followers, "on our twenty-five camps, lies the dark stain of a man's murder; * we must, as much as it is in our power, blot out the shame."

On bidding farewell we gave him a present, which pleased him enormously, and amply compensated him for his kind assistance. Nevertheless, after the departure of our guests from camp, we discovered that an enamelled iron cup, which he had taken a great fancy to, had disappeared from one of our tents. It should be mentioned that, having learned by bitter experience the shameless way in which Tibetans invariably and continually begged, and of their uncontrollable tendency to theft, we always, when expecting a visit, made a point of concealing our private property, so as not to lead these savages into temptation more than could be helped. Our friend the old man personally guided us for two days, camping with us at night at the foot of the sacred mountain Chumuik-rapkha, which was covered with a dense forest of tall junipers. On my asking him to come and shoot in this wood, he replied in the affirmative, but it was not difficult to read from his face that he did not want to accompany me. Seeing this, and as there did not appear to be any unusually rare birds, I decided not to shoot.

In the I-chu valley, close to where the Dunchjon stream joins the river on the left bank, there is a small curiously shaped hill, called by the Tibetans Vak-khelkhari. According to tradition, this hill, which is now overgrown with grass, was once the favourite camping-ground of the great Gesur-Khan, in the days of his campaigns. His camp used to be pitched round it, and on the summit his enormous helmet was always placed. When we passed this historical hill, we found close to

* He apparently referred to Dutreuil de Rhins. In the majority of cases Tibetans have no conception as to the division of European races by nationalities

it a travelling monastery, from which proceeded the sound of a prayer-tambourine. The night before arriving at the R'kombo-tso lake we camped at a place which, according to legend, was equally interesting, namely, where two separate little hills, personifying a fish and an eagle, stand close together. The latter hill vigilantly watches the former, to prevent its moving into the lake, which, according to tradition, would portend a second flood. Every summer, in the wide valley close to these hills, the Tibetans hold a military display, which is followed by a general debauch.

On the last day of July the expedition reached the northern shore of the lake, where a piece of ground close to the dwelling of the local headman was assigned to us. This headman—head of the R'khombo-doma encampment—appeared to be frightened, like his nomad neighbours, and was exceedingly dirty. On shaking hands, he proffered to me the customary gifts, welcoming me with a trembling voice. The reason for the fear displayed by the lake nomads transpired to be that they believed we had come to avenge the death of our comrade, Dutreuil de Rhins, who had been killed by Tibetans of the Det-ta encampment. The lake, which not long ago had contained a quantity of water, was now merely a marsh, overgrown with reeds. During our stay by its shores there glistened in places, midst the bright green reeds, large and small patches of fairly clear running water. The circumference of this marshy lake was about 20 versts, conforming in shape to the lie of the valley. The depth was not more than 2 or 3 feet in places where we were able to measure it. The bottom was composed of mud and slime. According to my aneroid, the height above the sea was 13,730 feet.

We saw the following birds on the lake: black-necked crane (*Grus nigricollis*), the Indian goose, the *Totanus calidris*. Further out on the open patches of water were duck, and, every now and then the *Sterna hirundo* flew across from side to side. Amidst the grass were long-tailed and white-tailed eagles (*Haliaetus albicilla* and *H. Macei*), and large larks (*Melano-corypha maxima*), which on clear bright mornings broke the surrounding stillness with their song. Occasionally martins darted through the air, as well as hill and land swallows. In the near hills black-headed larks and wild doves made their homes. Animals were conspicuous by their absence, with the exception of the antelopes, which came out each morning to feed on the grassy slope of the opposite shore. The reason for their scarcity was not far to seek, namely, the nomads, whose tents blackened the surrounding country, and whose large herds of yaks and flocks of sheep were everywhere to be seen. Occasionally we came across droves of ponies, the Tibetan's best weapon against the mischievous intentions of his neighbour.

During the few days of August which we spent by the R'khombo-tso the weather was showery. The blue sky was seldom visible, for clouds were continually coming from east or west, bursting into rain-drops over the thirsty lake. Thunderstorms were of frequent occurrence, accompanied usually by snow and hail, and in the evenings, to the south-east, we often saw summer lightning. The minimum temperature here was zero, and when at zero hoar-frost covered the ground. The local people, curiously enough, attributed the continued bad weather to our shooting, and used to tell us that if we would desist, the weather would at once clear.*

While here, Kaznakoff made an expedition to sketch the neighbouring lake Chjoma-in-tso, which lay 35 versts to the south-west, resting its salty waters in a deep valley. Round the open clear water of this lake, which was 30 versts in

* Throughout the whole period of our travels shots were always to be heard near the camp, or wherever we might be. Our men were always out shooting.

circumference, grew quantities of reed grass, winding among which were little streams flowing into the lake. The bottom of it was flinty, judging by the shores, and there appeared to be seaweed. On the surface geese and cormorants were swimming about, and the presence of the latter indicated that there must be fish. In our spare moments we did what we could to add to our supplies, buying sheep and butter from the Tibetans, who were willing dealers, being anxious to obtain silver with which to pay their taxes. Our stay by the shores of the R'khombotso, which was longer than we had originally intended, was marked by the sudden illness of the head guide, with whom we were most reluctant to part. But he rapidly grew worse, and so, after leaving him in hospital* in the charge of the local headman, we set forth without him. Our path lay east-south-east, where the valley was hemmed in by red-brown hills of marl and conglomerate.

Keeping on in a south-easterly direction, and after descending again into a cultivated region, we reached on our fourth march Chjerku, a village 12,090 feet above the sea. Now that we were again near the Blue river, we particularly noticed the warm and comparatively dry air. The rainy weather and somewhat raw air had been left behind when we crossed the Tsz-la pass (14,650 feet), whence the small stream Dza-chu, which joins the Ba-chu† at Chjerku, brought us to our camping-ground. At Chjerku nomads put in a temporary appearance, merely visiting the place so as to exchange their raw materials for articles of daily need.

Thinking to spend some time here so as to come to an understanding with the local authorities with regard to our onward journey, and as we were expecting to meet the Chinese, whose advanced party had already arrived, we arranged our camp close to the village, on the bank of the stream, and sent our animals up the Dza-chu to the fertile and hospitable ground by Darin-do.‡ This was famed for its waterfall, Gochinda, beside which we spent the last night before arriving at the monastery. At Darin-do, at daybreak one morning, a band of some thirty Tibetan thieves made an attack upon the camp where six of our grenadiers and cossacks were living in charge of the animals. Fortunately the ruffians were seen in good time, and were easily repulsed by rifle-fire. To which encampment they belonged we were never able to discover.

Chjerku|| is a fairly large village consisting of about a hundred mud houses, and is conveniently situated on the southern slope of the eastern extremity of the Dutreuil-de-Rhins mountains. On the valley side it is fringed with fields of barley

* The sick man definitely declined to touch any of the remedies of the quack lama doctors, being suspicious of treachery — of being poisoned — especially after our departure.

† The two streams, joining together, form a large one, called the Tszan-da, which is a right-handed tributary of the N'dui-chu.

‡ Five verstas to the west of Chjerku.

§ Here, as well as in the Dza-chu valley, we found new specimens for our herbarium. They were principally grasses; and high up were herbs, gentian, wide-leaved rhubarb (*rheum*), delphinium. Lower, besides the shrubs already mentioned, grew three kinds of gentians, orchis, a pink epilobium, saussurea, and two or three plants unknown to us. Near the waterfall there were salix, umbelliferae, and gramineae; and in Chjerku, triticum, gentiana, linum, labiatae, compositae, and cuscuta.

|| Rockhill, in his 'Land of the Lamas,' calls this village a town, and gives it the name as "Jyekundo," pointing out (*vide* note 9, p. 206) that it is sometimes called "Jyék'or." Pundit A.-K. calls Chjerku "Kegedo" (*vide* 'Report on the Explorations in Great Tibet and Mongolia,' made by A.-K. in 1879-82, prepared by J. B. N. Hennessey (Dehra Dun, 1891, p. 59). I noticed, however, that the natives call the village Chjerku, and the local monastery Kegedo.

which, when we were there, from August 9 to 20, were quite ripe, and were being cut. To the east of the village the rich monastery of Kagedo, with its 500 lamas (disciples of the old school), looks particularly handsome and imposing, perched as it is on the summit of a steep hill. It is supported by nine encampments, and is directly subordinate to the chieftain, a man called Rada, who is head of the local encampment. He is assisted by two men, one of whom is in charge of the nomadic population, and the other of the agricultural families. Of an evening both of them, without their people knowing it, used to come to our camp, but they were always very reserved in their conversation. Our attempts to explain to them the difference between the English owning the country to the south and Russians living far to the north were not of the slightest use. Like all other inhabitants in eastern Tibet, they took us for Englishmen, just in the same way that many Mongol tribes call the English Russians, when they happen to travel in the confines of Mongolia, eastern Turkestan, the Koko-nor, and the Tsaidam. It was interesting to note how the Tibetans could never look at those of us who had fair hair and eyes without feeling certain that we were English. The head "gégón" or "bey-khu" also evinced great interest in us, and he gave Kaznakoff an interview in the village one evening. He was affable, but very reserved, like his deputies. From the simple inhabitants of Chjerku we heard that the Lhasa government was anything but pleased with the Tibetans of Sining Kam, because, apparently, during the last five years they had paid nothing to the Dalai-Lama.

Thanks to its position on the great Ssü-ch'uan-Lhasa road, Chjerku is enlivened by the constant passing of merchant caravans, who keep large depôts of goods here, chiefly comprising tea. Every year trade to the value of more than 100,000 lams passes through, while from Ssü-ch'uan to Lhasa is imported, besides tea, which constitutes 70 per cent. of the export trade of China into Tibet, cotton cloth, silk, crimson cloth, sugar, Russian leather, and chinaware. The exports from Tibet consist of wool, fur, musk, horns of stags, pastille, statuettes, gold, and a few other products. Almost every day the tents of new-comers can be seen in the valley, resembling drops of ink spilled on green paper, attracting the attention of the local population. The village and monastery seem to be equally favoured. In fact, fresh arrivals move about freely to distribute news, playing, like all caravans in Central Asia, the part usually falling to the press. Our little camp came in for its share, being besieged by curious-looking and invariably cunning Tibetans, amongst whom we once saw a musician who performed on a one-stringed instrument. To my proposal that he should sell it, he at once declined, pleading that, as he had no other source of income, he would lose his livelihood.

From our tents we had a glorious view of the southern mountain chain in the distance, which, south-west of Chjerku, was often crossed by long strings of bull caravans moving towards Lhasa, or from Lhasa to Ssü-ch'uan. Close to us stretched a fairly broad valley, whose pleasant green surface was intersected by silver brooks uniting with the larger streams. It was the pasture-ground of donkeys, calves, and goats, with which the village children frolicked all day long, in groups of boys and girls. The former tried to race with the donkeys, but rarely succeeded in getting anything out of the stupid brutes, and generally fell back upon the goats, driving them into the water. The girls, as a rule, were merely modest spectators of the boys' exploits, and preferred to remain near their mothers, who were busy washing clothes. The shouts of their merriment and light-hearted laughter resounded along the banks of the stream. In the clear waters of this rapid-running stream we were most successful in netting fish, which belonged to the *Schizopygopsis thermalis* family mentioned previously. Our collection was supplemented by a specimen of the *Nemachilus stenurus*.

On the day of our arrival at Chjerku a Chinaman brought us news from Ivanoff, who had safely reached the depôt at the Tsaidam. He reported that, while on his way back, the men in charge of our camels, horses, and sheep at the depôt had been attacked by a band of Tangut robbers, belonging, it was thought, to Raugan's encampment. Luckily my two young travelling companions, Teleshoff and Afutin, kept their presence of mind, and succeeded in repulsing them, despite their numbers and the fact that the attack was renewed at intervals throughout the night. In the morning the brigands decamped, and two or three hours later my men drove the animals from the hills into the plains, to the depôt. Here their senior, Muravieff, in Ivanoff's absence in Tibet, was able to assist them by deeds as well as words. This repulse taught the Tanguts to leave us Russians henceforth in peace. We were told afterwards by the Tsaidam Mongols that the Tanguts abandoned their attempts to steal our animals, as they had suffered a loss of some three or four men in the affair. They, however, sought to avenge themselves for this by making many attacks upon Mongol encampments in distant parts of the Tsaidam.

On the third day of our sojourn in Chjerku we received a visit from Chinese officials—the tax collectors. Notwithstanding the wet weather, their entry into the village was made by the *gégén* or “*bey-khu*” an occasion of ceremony. Lining the road or standing on the roofs of the houses, the lamas blew their horns, played their flutes, and waved flags, while the poorer folk gaped at the incomers, exchanging greetings with such of the scribes, soldiers, or interpreters as they were acquainted with. When the Chinese officials called upon us, they arrived so early that we were still in bed, and were in consequence compelled to keep them waiting for some little time outside the camp. The next day we returned their visit. Both of the Manchurian officials endeavoured to assist us as far as they were able, but they confessed that they had little power here with regard to anything which was beyond the scope of their mission. Indeed, the only way in which they were able to be of assistance was enabling us to exchange their silver for Indian rupees, and by getting the question settled of securing provisions and reliable guides for our further movements into the territory of the Khan Nauchin-chjalbo.

During the twelve days of our sojourn in Chjerku we were often invited to the Chinese camp, and they in turn were entertained by us. They always complained of the dullness of the place, and of the weary waiting till they could return to Sining Fu. The Chinese are a very domesticated people, and fond of family life, so here, as in other places, they took to themselves temporary wives from among the local ladies. These sometimes accompanied their husbands back to Donger or Sining Fu, where, though seduced and betrayed, they were abandoned by the Chinese, and compelled of necessity to carry on a life of pleasure. This accounts for the inhabitants of some nomad Tibetan camps we met, on mistaking us for Chinese, asking us “if so-and-so and so-and-so, their wives or daughters, who had been taken away by Chinamen on a previous occasion, were with us? and if they were not of our company, could we tell them how they fared abroad?” Some of their eyes were even filled with tears.

Neither we nor the Chinese received news from our own country, so that we were utterly ignorant of the Chinese-European war being waged in the Far East, otherwise our modest dinners with the usual toast to our respective nations would have been somewhat out of place. I gave the Chinese a packet of letters to be despatched on their return, in one of which I briefly informed the Geographical Society of the progress we had made since entering Kam. The fate of this letter is, alas! still unknown.

REVIEWS.

EUROPE.

ALPINE PLANT LIFE.

'Das Pflanzenleben der Alpen. Eine Schilderung der Hochgebirgsflora.' Von Dr. O. Schroeter. *Maps and Illustrations.* Zürich: Albert Raustein. 1904-1908. 17 marks.

The alpine, that is, the mountain-plants only, of Switzerland, are included in this most interesting floral monograph. Every type of vegetation is worked out most thoroughly, and the book before us can well serve as a model for all future research on alpine vegetation in general. The thorough nature of the author's work can be shown by referring to one group of formations only in particular, namely, the "Gesteinsfluren." These include all those types of vegetation where the latter is interrupted by the exposure of any form of stone, from the solid rock to the finest sand and mud. A very careful account is given of the cushion-plants, comparison being made with similar plant-forms found in Kerguelen and the Algerian Sahara. Identical conditions produce similar plant-forms. The more adverse these conditions are, the more marked does this similarity become. This point is well illustrated by photographs of *Azorella selago* (Kerguelen), *Anubasis arctioides* (Sahara), and *Androsace helvetica* (Albula pass). Reference is also made to the importance of lichens, algæ, and moss on the very outskirts of alpine vegetation. The lichens especially cover the bare rock-face, and they initiate the first crumbling away of the native rock. They prepare the rock for the large plants, and mosses follow them, when the surface of the rock is no longer smooth. The lichens are thus seen to be of great geographical importance.

Some idea of the scope of Dr. Schroeter's book can be given by enumerating the titles of the six main sections of his alpine flora: (1) The relation of the alpine flora to the whole vegetation of the Alps; (2) the natural conditions of the alpine region; (3) the chief representatives of the mountain flora of the Alps; (4) the ecology of the alpine flora, with regard both to the vegetative and reproductive organs (the latter by Dr. Günthart); (5) modes of dispersal (by Dr. Vogler); (6) history of the Swiss alpine flora (by Dr. Marie Brockmann-Ierosch).

O. V. D.

ASIA.

CENTRAL ASIA.

'Opisanie Puteshestviya v' Zapadny Kitai,' sostavleno (I. E. Grum-Grzhimailo. Tom iii. St. Petersburg: Typographiya V. F. Kirshbaum. 1907. Pp. 531. *A Map in three sheets, 25 Phototypes, and 29 Zincographs in the Text.*

Unfortunately Mr. Grum-Grzhimailo has been frequently interrupted in the working out of the materials for his third volume by various other occupations in the public service. The expedition of the brothers Grum-Grzhimailo, which took place in the years 1889-1890, was of great importance in its day, and those who take only a superficial interest in geographical progress will remember their exploration of the Tian-Shan and its great mountains Dos-Mogen-ora and Bogdo-ola, their discovery of the singular Liukchun depression, and of the mountainous belt stretching south-east of Hami, to which they gave the name of Pe-shan. They were also the first travellers to shoot and bring home specimens of Prjevalski's horse. After seventeen years, however, this volume must lose its freshness as a mere narrative of travel, especially as much additional knowledge of the districts traversed has been obtained by later travellers, whose achievements tend to obscure, though they cannot really detract from, the merits of the first pioneers.

In the present volume the author describes his homeward journey from the Hwang-ho round the western end of Kuku-nor, across the Nan-shan and Pe-shan, for the most part by routes lying to the south-west of his outward course, and along the northern flank of the T'ian-shan. To the geographical worker this record of observations will not have lost its usefulness by lapse of time, and the delay in publication has had this advantage, that the author has been able to compare his results with those of later travellers—Obruchef, Fütterer, Kozlof, etc. The book also contains several interesting chapters on ethnological and zoological subjects, a list of botanical specimens, and other scientific matter.

KAMCHATKA.

'Po Zapadnomu Beregu Kamchatki.' V. N. Tiushova. St. Petersburg: Typographia M. Stasiulevicha. 1906. Pp. 521. (*Zapiski of the Russ. Geogr. Soc.*, vol. 37, No. 2.)

Dr. Tiushof has passed more than ten years in Kamchatka, and in numerous journeys, in connection with his professional duties, has become acquainted with many remote parts of the peninsula. Not having had a scientific training, he claims no scientific importance for these records, but a careful observer may collect many details which may be utilized by others. And this seems to be the opinion of Mr. Bogdanovich, who has marked his approval of the work by writing an introduction. He takes exception to the author's conclusion that the surface form of the tundra of the west coast lands is due to marine action, and that of the higher tundra to the action of glaciers. There is no evidence of a Post-Pliocene sea extending to the foot of the central chain, and the glaciers of Kamchatka have attained a great development only in certain parts. The most valuable part of the work, Mr. Bogdanovich affirms, is the account of the inhabitants. The life of the Kamchadales, their occupations and industries, are most interestingly portrayed, and since Krashenninnikof's book this is the first attempt to depict the native of Kamchatka as a human being.

In these pages Dr. Tiushof takes the reader from Petropavlovsk to Apacha and Bolsheretsk, and thence across the coastal lands to Tigil. A special chapter is devoted to the language of the Kamchadales. A reproduction of the map drawn up by MM. Bogdanovich and Leliakin in 1901 is appended, in which their transcription of the place-names is retained, simply to avoid the labour of alteration, though the author's geographical nomenclature is undoubtedly more correct.

AFRICA.

SOUTH-WEST AFRICA.

'Aus Namaland and Kalahari.' By Dr. Leonard Schultze, Professor of Zoology in the University of Jena. With 25 Photographic Plates, a Map, and 286 Illustrations in the Text. Pp. xiv. + 752. Jena: Gustav Fischer. 1907.

As explained in the long sub-title, and more fully in the preface, this really ponderous tome—it weighs nearly 8 lbs., and being of large quarto size cannot be handled without great inconvenience—is an official report which the author has presented to the Prussian Royal Academy of Sciences on his explorations in parts of South-West Africa during the years 1903–1905. The surprise that such a huge volume should be needed for the purpose of recording the observations made in a tolerably well-known corner of the continent, long under European administration, is increased when we learn that all the usual incidents of travel are omitted, while the rich biological collections are reserved for separate treatment by specialists. Here we have, in fact, little more than a very careful physiographical survey of the inhospitable seaboard, and of the still more inhospitable inland districts visited by

the author, together with an almost painfully minute account of the aborigines. Dr. Schultze was at first commissioned to make a scientific study of the fishing-grounds along the south-western coastlands, with a view to determining their economic value. But the scope of the expedition was afterwards enlarged, so as to include such tracts of the interior as might be accessible under the unsettled political condition of the German protectorate, where the widespread risings of the natives have not even yet been everywhere suppressed. He was thus enabled to make a close study of some of the most primitive peoples in the world in association with their physical environment, and this is what lends its special interest and main scientific value to this monumental work. "In the course of my investigations, the more complex appeared the attempt to find a common basis for the conditions of existence of the animal and vegetable worlds in their determining activities and mutual reactions one on the other, the more fruitful at the same time appeared the solution of the problem, for it became clearer and clearer with every step in advance how the question, once thoroughly grasped, led to a direct understanding of the natural surroundings, which assigned its limits to the range of the local flora and fauna, and stamped their physical and mental characters on the aborigines."

The region actually explored comprised most of Damaraland, Great and Little Namaqua Lands, and the Kalahari desert, approached from the east (British Bechuanaland) and from the west (the German Protectorate). Specially favourable opportunities were thus afforded for studying in their homes all the South-West African races—Bantus (Ova-Hereros and Bechuanas), Hottentots (Namas), Bushmen, and half-breeds (Hill Damaras and Bastaards). A main object, the author tells us, was to acquire a thorough understanding of the social relations prevalent amongst these aborigines, for which purpose he undertook the arduous task of gaining a practical knowledge of the difficult Hottentot language, and also everywhere paid great attention to the selection of competent guides and interpreters. The rich materials thus brought together are disposed in five distinct sections, each with a number of chapters (fifteen altogether), which may be described as exhaustive, at least as regards their geographical and ethnical contents.

To the somewhat copious information already available many valuable particulars are here added regarding the physical and mental characters of the natives, their primitive beliefs, customs, traditions, folklore, and "oral literature." Some fresh light is also thrown upon several matters, regarding which vague or erroneous views have hitherto prevailed. Thus the real nature of the bushman and Hottentot clicks would appear to have been hitherto misunderstood, and it is here shown that these inarticulate sounds are not produced by inspiration, as is commonly supposed (Hahn, Steinthal, and others), but exclusively by the action of the tongue, in which the breath plays no part whatever. "*Dieses Einströmung [der Luft] ist keine Inspiration; Die Unabhängigkeit von Zwerchfell und Lunge ist meiner Auffassung nach das Charakteristische der Schnalzlautbildung*" (p. 342). The "heterodox" view here advanced is based on the closest observation of the mouth during utterance of the four clicks (dental, labial, cerebral, palatal), and is developed by a carefully prepared tabulated scheme, clearly showing the various positions of the tongue in the formation of this primitive phonesis.

It is generally assumed that south of the Zambezi the artistic faculty is confined to the Bushmen, and on this assumption the late Dr. Stow bases a theory regarding the origin of these natives ('Native Races of South Africa'). But here again Dr. Schultze makes it clear that this is a fallacy, and that the æsthetic feeling is strongly displayed even by Hottentot children, from eight to sixteen years old. They make clay models of horses, cattle, antelopes, fat-tailed sheep, goats, frogs, lizards, scorpions, even waggons with long teams, and then fire the clay, both to

harder it and give it various shades of colour. Noteworthy is the skill with which the characteristics of the different animals are hit off, with the same unconscious efforts as those displayed by the cave men of palæolithic times. Yet, strange to say, this sense of plastic art completely dies out in the adult Hottentot, though not in the Bushman. Nor is the latter as destitute of tribal organization as he is usually described, wandering about in disorderly hordes, like baboons in search of food—a point also noticed by Dr. S. Passarge in 'Die Buschmänner der Kalahari.'

The Hottentots are stated to call themselves *Khoi Khein*, "Men of men," as if they thought themselves the *crème de la crème*, or lords of creation. But Dr. Schultze again tells us that this is not so, the expression being chiefly used in reply to a question regarding their tribal connections. In the mouth of a pure Nama it simply means that he is a full-blood native, and not a mongrel or half-breed like his Bastard or Griqua neighbours.

In the long section (over 200 pages) devoted to the mental qualities of the Namas, there is a valuable collection of sixty-eight national legends, which are all the more welcome since hitherto the rich Hottentot folklore has been strangely neglected. This, no doubt, was mainly due to the difficulty of dealing with the oral texts of a language full of unpronounceable clicks and structural complications, so that the few tales published by Bleek appear only in translations, which are so modified and otherwise defective that they fail to reflect the real spirit of the originals. This is here thoroughly preserved by Dr. Schultze's treatment, which disposes the material in five groups—adventures in the wilderness with cannibals and wild beasts, sagas of the Hill Damaras, family and pastoral stories, myths of eponymous heroes and of the olden times, and animal tales. Then each saga is given in the original text reduced to a uniform system of transcription, and this is followed by a close translation in which grammatical forms and idioms are explained within brackets. The folklore is followed by a considerable number of popular riddles, which are treated in the same way, and serve to further exemplify the mental character of the people. A few instances may be given. There is a very little thing which brings big ones—money. What runs after another and never overtakes it? A wheel. There is a thing which looks easy to catch, but which you will never catch—your shadow. What is it you stuff full and then starve? Your gun. What is it you see even in the dark, however far or near it be? Fire. A wide red gorge is edged all round with white things—the mouth and teeth.

There are several indexes, a very fine large-scale map of the routes followed, and some splendid photographic reproductions of Bushmen, Namas, and Bechuana, of geological formations, characteristic scenery, plants, and animals, altogether 25 plates and 286 illustrations in the text.

A. H. KEANE.

AMERICA.

MEXICO.

'Mexico of the Twentieth Century.' By Percy F. Martin. 2 vols. London: E. Arnold. 1907. Price 30s. net.

This book is a useful reminder of the great change that has come over Mexico during the last few years. It is no longer the land of the diligencia and the bandit; we can spare them both; but, alas! the charro dress, the mantilla, and the high comb are also becoming obsolete.

The author of this book does his best to show us Mexico up-to-date by passing in review the Departments of Government, the Army and Navy, the Judicial System, and the condition of Education and Religion, and then devotes many pages to Banking, Insurance, etc., and gives a full account of the lines of railway. His

enthusiasm for his subject is his best excuse for the over-laudation which pervades his writing. Mexico is certainly a most interesting and charming city, but the author goes so far as to say (p. 182), "Already sufficient has been effected to evince that Mexico will be more beautiful than Paris, more admirably planned than Vienna, and a distinct improvement on Berlin."

The opening sentence of the first volume should prepare us for some want of historical discrimination, for it states that "during the whole of the three hundred years during which Mexico was subject to Spanish rule, not one single act of grace, of consideration, or even of common fairness towards the Colony can be traced." If the author intends this sweeping assertion to cover merely commercial relations there is some sort of justification if we judge only by modern standards, but if it covers the attitude of Spain towards the Indians of America, we may quote Herman Merivale, who says, "It is truly said by Heeren that 'no European Government did so much for the aborigines as the Spanish,' and although most writers have coupled the admission of this fact with the general assertion that the good laws established by the mother country were absolutely set at naught by the rapacity of the colonists, yet the state of ease and prosperity in which the Indians lived at the time when the recent revolutions commenced most distinctly contradicts this position." *

The second volume contains a description of each State in alphabetical order from Aguas Calientes to Yucatan, and chapters on trade, manufactures, and mining. It does not add much to our knowledge of Campeche to be told, "It has cool and shady forests stretching away for hundreds of miles, but therein lurk deadly fevers and noisome insects; it has luxuriant savannahs, verdant lagoons, and many beautiful lakes, but in them are the haunts of malaria, poisonous reptiles, and deadly vapours. . . . The rich forests, filled with valuable dye-woods, stretch right down to the water's edge; but it is certain disease, and frequently death, to penetrate far beyond their borders, the Indian alone finding safety within their dark and fever-laden depths. . . . No doubt the State of Campeche contains many good and promising mines—at least, such are suspected to exist—but the climate is so trying, and the labour available so poor and unreliable, that the industry has been almost untouched." The climate of Campeche is no worse than that of any other tropical forest land near the sea-level, and the rich mines would indeed be a revelation.

The description of Chiapas ends with an account of the Ruins of Palenque, "one most important factor in the many attractions of Chiapas must inevitably be the marvellous—perhaps the most marvellous of all—ruins to be found at Palenque. Every other prehistoric city in Mexico, and indeed in the world, must yield pride of place to this, a verdict pronounced and endorsed by every archaeologist and antiquarian who has ever seen the great ruins of the universe." Also in chapter xxviii. it is stated that "In Mexico may be seen, scattered over the face of the vast territory—which covers some 1,987,201 sq. kilometres of superficial area—ruins older by many centuries than those of *Caldæa* and *Syria*, of *Karnac* and *Memphis*, and more beautiful than those of the *Temple of Ephesus*," etc. It would be difficult to condense more errors into a few sentences, and, considering the large number of trustworthy books and pamphlets on the subject, the author might have taken the trouble to consult some of them. However, this book is a compilation, tempered by a certain amount of personal observation of some districts, and it fulfils a useful purpose in bringing a good deal of information within the covers of two volumes, although it still requires much revision and correction.

The illustrations are numerous and good, but we must protest against our old

* Lectures on Colonization and Colonies, delivered at Oxford, 1839-41.

friend the great cypress tree of Sta. Maria del Tule (which has been described by every traveller in Mexico from Humboldt onwards) being labelled "A Banyan Tree." That is almost as bad as the natural history in the last English book on Mexico, which taught us that "humming birds do not sing," and that "a manatee is a small kind of hippopotamus which lives in swamps."

There is still room for a good all-round book on Mexico.

A. P. M.

CLIMATE AND RIVER-DISCHARGE IN CENTRAL AMERICA.

'*Belträge zur Klimatologie und Hydrographie Mittelamerikas*' By Dr. Alfred Merz. *Mitteilungen des Vereins für Erdkunde zu Leipzig*: Duncker und Humblot. 1906 (1907). Pp. 96. *With numerous Diagrams.*

The meteorology of Central America has been described by Mr. A. P. Davis in his 'Hydrography of the American Isthmus,' Twenty-second Annual Report of the U.S. Geological Survey, 1900-01, Part IV. (Hydrography), pp. 507-630. The present memoir refers more especially to the drainage basin of the San Juan, including Lakes Managua and Nicaragua and the coastal region on either side.

In the tract of country bordering on the Caribbean sea the trade winds blow continuously from November to April, and nearly half the rain falls during these months. A comparatively dry period occurs from February to April, when the adjoining sea has the lowest temperature, and the trade winds blow most strongly, though one can hardly agree with the author that the latter circumstance on an elevated coast-line contributes to a decreased rainfall. During the period of the summer rains, from May to October, the trade winds lose in strength, and alternate with winds from other quarters. The total annual rainfall varies from about 110 to 250 inches, totals which are not reached elsewhere in Central America. There are two maxima, in July and November.

To the south-westward the conditions are slightly modified; the trades, which blow steadily from January to April, and to a less degree during November and December, are dry föhn winds that bring no rain. The rest of the year is characterized by calms, or light winds from various quarters, determined by the north or southward movement of the region of minimum pressure. During this period the rainfall is connected with upward movements of the air due to local heating. More than 90 per cent. of the rain occurs in the period from May to October, but it is less than that on the north-eastern coast during the same months. There are two maxima, in June and October. The minimum rainfall, less than 50 inches in places, is just north-east of the lakes. Further to the south-west the rainfall increases, especially as the slopes of the Pacific coast ranges are approached.

On the south-west coast different conditions again prevail. The south-west winds become more important, and yield a considerable amount of rain as they meet the hills, the total rainfall being over 80 inches. The rainy season is still May to October, but the maximum in October is more marked than that in June.

The author discusses at some length the relation of the precipitation, evaporation, storage, and discharge in the region under consideration, and calculates that the percentage of discharge in different areas (other than the lakes) varies from 30.6 to 74.6.

His conclusions are displayed in a number of tables and diagrams, to which we have no space to do justice. It is only to be regretted that the observations on which they are based necessarily leave much to be desired in number and accuracy.

J. W. E.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

A FRENCH TREATISE ON GEOLOGY.

E. Haug, 'Traité de Géologie.' 2 vols. Vol. 1. "Les Phénomènes géologiques." Pp. 385, 195 figs., 71 pl. Paris: Armand Colin. 1907. Price 12 fr. 50.

The relations of geography and geology are so increasingly intimate that the first volume of Prof. Haug's important 'Traité de Géologie' has an almost equal interest for geographers and geologists. The author is Professor of Geology in the University of Paris, and is well known for his valuable researches on the physical geography and geology of the French Alpine regions; and among the chief features of this book is its excellent statement of modern knowledge as to the structure of mountain chains, and the diagrammatic illustrations by which the author explains many of the terms and theories of Prof. Suess.

The author discusses the relations between geology and geography, and says that "while geography analyzes more or less exclusively the existing forms of the Earth's surface, geology primarily regards the succession of the phenomena that have brought about the existing forms, and it often too much neglects morphological considerations. Hence the two sciences tend to-day to blend intimately, the studies of physical geography taking more and more a geological character, and geology, under the vigorous impulse given by Suess, turning towards regional studies." He insists that one essential character of geology is that it deals, not with the world as it is at any one date, but with the succession of phenomena, and with that geological cycle which the geologist should always bear in mind.

The first volume of Prof. Haug's treatise being confined to "Geological Phenomena," it deals largely with the problems of Physical Geography in their geological aspects; and even the most strictly geological chapters, such as the description of the material of the Earth's crust, may be read with interest and profit by geographers.

Among the chapters of special geographical interest are those summarizing biological geography. The evidence of the distribution of animals and plants is, in the author's opinion, conclusive against the belief in the permanence of ocean and continents. He holds that in Mesozoic times, the arrangement of land and water was fundamentally different from that of the present period, for there were then five great continents, one occupying the present basin of the North Atlantic; another most of the South Atlantic, connecting Africa and Brazil; a third covering most of the Indian ocean, and uniting Madagascar, India, and Australia; the fourth included China and Siberia; and the fifth and largest occupied most of the Pacific.

The author describes the Earth as composed of five zones, as, in addition to the ordinarily accepted divisions, he places a pyrosphere, constituted by a molten magma at a high temperature, between the lithosphere and the centrosphere. He accepts the hypothesis that the centre of the Earth is occupied by a metallic nucleus or barysphere, on the evidence afforded by the study of earthquakes; but his limitation of the term "barysphere" is an alteration in its meaning which will probably not meet with universal acceptance; and the very high density which the author accepts for the actual centre of the Earth is rendered improbable by Oldham's studies of the rate of transmission of earthquake shocks. The last chapter gives an account of the tetrahedral theory of the distribution of land and water, and helps to show the marked progress made in recent years by that once derided theory.

J. W. G.

HISTORICAL GEOGRAPHY.

HISTORY OF ANCIENT COMMERCE.

'Handelsgeschichte des Altertums.' Von Prof. F. Speck, Oberlehrer am Realgymnasium mit Höherer Handelsschule in Zittau. Leipzig: Brandstetter. 1900-1906.

We thought the Germans had given up this kind of thing. Here we have a work in five volumes in paper covers without a single stitch from beginning to end, so that if one cuts up the volumes they fall to pieces. The first two volumes are called, as one expects them to be, first and second, but the three remaining volumes are all called the third. The first third of the "third volume" is called the first half, and the remaining two-thirds are called respectively "second half A" and "second half B." The contents of the work, however, do not answer to the ineptitudes of the get-up. These are excellent. They furnish the most complete history of the commerce of antiquity that has yet appeared. The history is characterized by a mass of detail exhibiting genuine Teutonic industry, but at the same time may be commended for a degree of soundness of method in the exposition sufficient to make those details instructive, if not exactly light or even easy reading. It is in every case based on a careful (though not in every case faultless) study of the geography according to the conditions of the time, and the several sketches of the geography of the countries dealt with are followed by the broad outlines of the political history as affected by the geographical conditions, and in its turn affecting the history of commerce. As it is impossible to afford space to review the work at length, it will be enough to add a brief statement of the arrangement of the contents, and in doing so it will be convenient to speak of five than three volumes. The first volume is entitled "The Oriental Peoples." The first chapter is a general survey dealing with the extent, means, methods, and commodities of ancient trade (pp. 1-138). This is followed by a chapter on India and China, the author considering that, though the civilizations of Egypt, Babylonia, and China are older than that of India, it appears fitting to give the first place to India, because the trade with India, even down to modern times, has surpassed all other branches of world-commerce (p. 139). Chapters follow on Babylonia and Assyria, Persia, Egypt, the Phœnicians, Arabia, the Israelites, and a final, separate, though short chapter on Damascus. The second volume is entirely devoted to the Greeks. The third treats of the commerce of the Carthaginians, the Etruscans, and the Romans, down to the unification of [peninsular] Italy in 265 B.C. (The text, of course, corrects the somewhat misleading character of this general title.) The fourth treats of Roman trade from 265 to 30 B.C., and the last of Roman trade from 30 B.C. to 476 A.D. There are few precise references to authorities, an omission for which the author excuses himself in the preface to the second volume on the ground that his work is not intended for the learned, and that to have weighted his book with such ballast would have made it even more difficult for him to find a publisher. The first two volumes contain, however, a list of the works on which his own is principally based, a list entirely German. An even more serious want is an index, but fortunately the consultation of the work is facilitated by a full table of contents.

G. G. C.

SHORT NOTICES.

Australasia.—'In Australian Tropics.' By Alfred Searcy. (London: Kegan Paul. 1907. Pp. xxiii., 372. *Map and Illustr.* 10s. 6d. net.) Mr. Searcy has had a long experience in the Northern Territory. His book is cast in narrative form, and his introductory description and historical retrospect are very brief, but the
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narrative deals with such a variety of interests that the subject is really fully covered. The habits of the natives, the practices of white and coloured traders, fishing, pearling, and sport, are a few of its branches, about which the author, who held the position of sub-collector of customs at Port Darwin, writes with intimacy.

General.—'The Great Outposts of the Empire.' By Wilson le Couteur. (London: Federal-Houlder-Shire S.S. Lines. 1907. Pp. 223. *Illustr.*) At the outset, this book does not appear to be very aptly named, for it begins with a description of St. Vincent, Las Palmas, Teneriffe, etc. Most of the remainder, however, is occupied with Australia and New Zealand. It is, in fact, a guide to the route of one of the liners of the steamship companies above named; the whole work is certainly written so as to attract the prospective traveller.

'Through Europe and Egypt with Napoleon.' By H. E. Marshall. (London: Jack. [n.d.] Pp. ix., 213. *Maps and Illustr.* 1s. 6d.) This volume of Mr. Marshall's "Through the World" series is excellently contrived to meet its purpose of combining the study of geography with a historical narrative. The necessary geographical facts are given clearly, but not too heavily insisted upon, while the narrative is told simply, and, in its greater moments, not without impressiveness.

'The Record of an Aëronaut.' By Gertrude Bacon. (London: John Long. 1907. Pp. 358. *Illustr.* 16s. net.) This is a biography of the well-known aëronaut, the Rev. J. M. Bacon, who died at the close of 1904. He was hardly beyond middle age, and the reader feels that he left much valuable work incomplete, for the record of his energetic life shows how many interests he found and developed in the study of the air. Of these, the most noteworthy would appear to have been, not merely his many balloon ascents, but especially his proofs of the visibility of the sea-floor to considerable depths from the elevated position of a balloon (perhaps his most striking work in the geographical interest), his researches into acoustics, and his trials as to the use of the balloon in warfare.

'The Moon.' By Garrett P. Serviss. (London: Appleton. 1908. Pp. xii., 248. *Diagrams and Illustr.* 6s. net.) This popular treatise on the moon is written in the form of a dialogue—a scientist instructing one unlearned—a form which makes for attraction to the general reader, but is difficult to handle, from its tendency to become unnatural. However, a "journey over the moon," and some of the problems attaching to its study, are very clearly described, with the aid of a magnificent series of reproductions from photographs of the moon in its various phases and of details of its surface, made at the Yerkes observatory.

THE MONTHLY RECORD.

EUROPE.

Rivers of the Fribourg Plateau.—M. Gaston Michel discusses the evolution of certain rivers of the Fribourg plateau (the Gérine, the Gotteron, and the Taferna) in a recent issue of the *Bulletin* of the Geographical Society of Neuchâtel (vol. 18, 1907). The valley of the Gérine contracts into a ravine in three places from its source to the Sarine, each contraction corresponding to a line of hills running transversely in a north-north-east direction. The stream has not followed the longitudinal valleys, but has cut through the transverse ridges, this state of things being the result of a succession of captures from the Sarine. The Nessler added its waters to the Gérine and helped to cut a way through the barriers. The next stream, the Gotteron, receives the Galternbach and the Tasbergbach, and from their junction flows to the Sarine at Fribourg. The contrast between the

insignificance of the stream itself and the magnitude of the work it has had to do is marked. Like the Gérine, the Gotteron cuts through the transverse ranges previously referred to. The Tasbergbach must in ancient times have flowed longitudinally into the plain of Tavel, and joined the Taferna by way of the Langebitzenbach. It was further increased by the Nessler, which had not yet been turned aside by the Gérine. This longitudinal stream was finally captured by the transverse Gotteron, and left a dry valley bearing marks of fluvial erosion on its slopes. The Taferna draws its supply of water from the snows of the Burgerwald. These formerly passed into the lake of Frohmatt by way of the dry valley of Tinterin. At this place the Taferna received the first tributary from the plateau, the Kinkerainbach, which is the headwater of the Tasbergbach, the latter then joining the Galternbach at Obermühlethal. This stream has now been captured by the Gotteron, but before this took place the Taferna debouched by the dry valley of Tavel into the lake of Rohr. Of the latter, only a marsh with Quaternary deposits bearing traces of the river's course remains. Beyond this lake the river entered its modern valley—that of the Langebitzenbach.

Shipping of the Saale as affected by Climate.—In an article in the *Mitteilungen der Geographischen Gesellschaft zu Jena* (vol. 26), Dr. E. Engel considers the shipping on the river Saale and the extent to which it is affected by high water, low water, and ice. The uppermost part of the river as far as Harra, available as it is for only a little raft floatage, is left out of account. The remainder of the river, the part falling within the scope of the article, is divided into the raft-floating portions from Harra to the mouth of the Unstrut at Naumburg, and the shipping part proper from that point to the confluence with the Elbe. The latter part, from Naumburg to the mouth, is again subdivided into the part from Naumburg to Halle, the trade of which is local, and the part from Halle to the junction with the Elbe, the trade of which is with the Elbe. From Harra to Naumburg there is occasionally a very busy raft industry, facilitated by special apparatus for passing the weirs. The weir at Kösen is, however, furnished with no such means of passage, and at low water the rafts have to be taken to pieces and then put together again. In general, however, low water offers no great obstruction to raft-floating. Even in 1893, the driest year of the period surveyed (1893-1904), when in July and August shipping was at a standstill, the raft trade suffered little abatement. High water, again, is no impediment to the floating of timber. On the contrary, the greatest bulk of wood is floated in March and April, the two months of high water due to snow melting. Afterwards, the amount floated steadily declines, to remain at a constant figure during the last four months. In December and January, as a rule, ice blocks the passage of rafts. Officially, a raft denotes two pieces rafted together. A raft of seven pieces counts therefore as three and a half rafts. The breadth of the rafts keeps pretty nearly uniform. Statistics both of the raft and ship traffic are given in tables. There are also tables of low water, and of the number of boats passing and their total burdens, at different ports, for each of the twelve years. A graphic table also shows the days in each year when navigation was hindered by high water, by ice conditions, etc., at Freyburg and Trotha locks. It is noteworthy that in 1873 the freight passing Benditz was twenty-four times the amount that passed in 1906. In contrast with that on the lower Saale, trade on the Unstrut and upper Saale is in continuous decline. In 1905, thirty-two boats were running the upper river; now there are only twenty-four, some of the larger ones being laid aside, and no new ones built—a depression due to the competition of the Unstrut railway.

The Southern Karpethians.—The chain of the Karpethians is usually considered to commence on the north side of the Danube near Pressburg, and after

describing a long arc to terminate at the Iron Gates. Three sections of very different characters may be easily recognized. The northern Karpethians are a group almost as broad as long, consisting of a series of chains running for the most part east and west, and culminating in the Gerldorfspitze, in the Tatra mountains, 8735 feet, the highest point of the whole range. From the Dukla pass to the valley of the Buzeu extend the central Karpethians, of much diminished breadth and height running from north-west to south-east, and composed almost exclusively of flysch. A very different region lies between the Buzeu and the Iron Gates. Crystalline rocks predominate, and summits of over 6500 are more numerous than in other parts of the Karpethians, though there is none as lofty as some in the Tatra mountains. These are the southern Karpethians or Transylvanian Alps (in English maps usually named the eastern Karpethians). The morphology of this group is the subject of a long article by M. Emm. de Martonne in the *Revue de Géographie*, 1906-7. The orientation of the southern Karpethians is in general east and west, but to the west of the river Jiu the chain turns abruptly to the south, at the same time broadening out. The defile of the Iron Gates is but a narrow gorge, and the same form of relief and geological formations may be traced southwards to the Timok. The Karpethians are not a single whole, but consist of two chains of very different ages and characters—the flysch region which was subjected to folding down to the latest Tertiary times, and a comparatively ancient massive, the Alps of Transylvania, which owe their present configuration to the combined effects of great overthrusts and denudation guided by movements of the Earth's crust which have been prolonged down to late Tertiary times. In short, the history of the range is the same as that of the Alps, but the processes of evolution have been less sudden, and have been continued through a long series of geological periods. M. de Martonne examines the various sections of the southern Karpethians and their relations to the adjoining hills and plains, accounts for the passage of the Jiu and Oltu through the range, and points out where further investigation is still desirable. The glaciation of these mountains is fully demonstrated. Above 6500 feet glacial action is strikingly evident, having produced two forms of summits—plateaus edged with isolated cirques and jagged crests due to the juxtaposition of cirques. But glaciation is of importance only as regards the higher summits. The forms are in general due to tectonic dislocations and cycles of erosion.

Investigations in Northern Iceland.—We referred some time ago (*Journal*, vol. 30, p. 436) to the disastrous expedition to Iceland undertaken last year by Dr. von Knebel, in the course of which that traveller and a companion were drowned in the lake of the Askja volcano. A third member of the party, Herr Spethman, was not with them at the time, but was able, after the sad event, to carry out investigations into the physical geography of the region, the results of which he has lately communicated to *Globus*, accompanied by several photographs. The journey to Askja was made from Akureyi on the north coast, and led over the inhospitable lava desert of the Odadahaun, the flat surface of which is entirely devoid of water or plant life. Askja, as is well known, is the central basin of the *massif* known as the Dyngjufszöll, which is marked by great regularity of outline, and is thought by Herr Spethman to be possibly one of the remnants of a plateau that once covered this part of Iceland. The travellers found that considerable changes had taken place since the basin had last been described, the lake having in particular increased in size and depth since Thoroddsen's visit. It is frozen over for ten and a half months in the year. The great basin of Askja is a caldera of subsidence on the largest scale, formed in a volcano of the Hawaiian type. There are two craters of different age, the later now occupied by the lake, to which

Herr Spethman gives the name of his lost companion (Knebel lake). This crater has breached the former one, which he has named Rudolf crater, after the third member of the expedition. The whole *massif* forms a striking example of eluvial relief, according to the nomenclature of Richthofen, the mountain being almost buried in its own *débris*, which gradually creeps down the slopes, and remains in the form of a talus at their foot, as there is no running water to remove it. Herr Spethman afterwards extended his investigation to the region between Aakja and the north coast, examining both the glacial and volcanic types of landscape, and paying special attention to the "Gjaus," or open rifts, with no outlet for the most part, which occur in association with the latter.

ASIA.

Obrucheff's Explorations in Chinese Dzungaria.—We alluded (*Journal*, vol. 28, p. 180) to the scientific work carried out by Prof. Obrucheff in 1905 in the region of the Tarbagatai and neighbouring ranges of Central Asia, and more briefly (vol. 29, p. 457) to the traveller's renewed explorations in the same region in 1906. A full account of the results of the second journey has now been given by Prof. Obrucheff in *Petermanns Mitteilungen*, 1908, Heft 2. The writer describes in detail both the morphology and geological structure of the mountain ranges explored (some of which were previously almost unknown), with occasional notes as to their vegetation, resources, etc. They stretch along the north-west frontier of Chinese Dzungaria south of the Tarbagatai-Saur range, forming a link between the Russian Altai and the Tian Shan. Orographically, they are separated by the Dzungarian "gate" from the Alatau on the west, though forming its tectonic continuation. They represent two distinct lines of highlands, the more northerly of which embraces the Barlik, Urkashar, Kojur, and Semistai ranges, while the more southerly is formed by the Maili, Jair, and Kara-arat. The Barlik and Maili ranges, forming the western ends of the two lines, are separated from the more easterly portions by the valley of the Kup and the depression followed by the Chinese post-road from Chuguchak to Shi-ho. They are not described in detail. Of the others, the direction is generally from west to east, though they sometimes show a slight trend to the north or south of this line. The separate ranges usually form more or less irregular tablelands, falling steeply either on the north or south. The Ukashar range, which as a whole has a triangular outline, consists of several distinct tablelands resembling a series of steps, the last and widest of these falling steeply to the south. The Semistai is narrower, and its highest ridge (forming an impassable barrier to baggage animals for some 30 miles) runs at its steep northern edge. The Jair, which also falls steeply to the north, has the general character of a tableland, especially in its northern part, along which the water-parting runs. The upper steps of the ranges are generally covered with alpine pastures, used by the Kirghiz and Mongols in summer, trees being found in the deeper valleys only. The successive ranges from north to south are separated by longitudinal valleys, which, however, are not drained throughout their whole extent by one and the same stream, while the ranges are broken here and there by transverse valleys. Of these the most pronounced is that of the Diam, which crosses both lines of highlands and, much diminished in size, finally loses itself in the same series of lakes as the Manas. Prof. Obrucheff's inquiries showed that the hydrography of these lakes and rivers has hitherto been incorrectly shown. As regards vegetation, the main depressions show every variety, from shady oases to barren wastes of gravel. Geologically, the ranges are largely composed of Devonian and Carboniferous rocks, with others of volcanic origin, while newer formations are found in the valleys. The present features are mainly the result of fracture, which

has given rise to a series of horsts and rift-valleys. Of useful minerals, gold, coal, and asphalt occur.

AFRICA.

The Westernmost Feeders of the Nile.—The information collected by Captain C. Percival regarding the extreme western units of the Bahr-el-Ghazal system, and published in abstract in the *Journal* for December, 1907, differed on one or two points from that supplied by Lieut. Comyn in the previous month's issue. In order to decide the doubtful points, Captain Percival wrote out a series of questions, which he sent to the Mamur of Kafakangi, with instructions to obtain answers from Sultan Murad and his sheikhs. The replies written down have been forwarded to us by Captain Percival, and as the latter carefully refrained from putting leading questions to the chiefs, they may be supposed to be trustworthy. As regards the name of the more southerly headstream of the Bahr-el-Arab, this is given as Bahr Adda (the name by which it has been known since Schweinfurth's time), not Barada (the form used by Lieut. Comyn, *Journal*, vol. 30, p. 528). The name (which means "custom") is said to be derived from the fact that the natives used to resort once a year to its banks for the purpose of holding a festival. Of the two headstreams the Adda is said to be the more important, as was thought by Captain Percival, being described as the "om" (mother), while the Umbelasher is the "walad," or child. The further information is given that the Bahr Miri is a large stream (in the rains) flowing into the Umbelasher on its right bank.

Geology of British East Africa.—Towards the end of 1905, Mr. H. B. Muff, of the Geological Survey of Great Britain, was sent out to British East Africa to examine the geology of the Protectorate in greater detail than had been done previously. The work in the field lasted till September, 1906, and a final report on the results has been issued during the present year by the Colonial Office (Colonial Reports, Miscellaneous, No. 45). As regards the broad features of East African geology, Mr. Muff's researches could hardly be expected to modify to any great extent the conclusions of so acute an observer as Prof. J. W. Gregory. Mr. Muff treats of the geology under the three broad subdivisions of (1) the coastal belt of sedimentary rocks, dipping at gentle angles towards the coast; (2) a broad region of gneiss stretching inland to the edge of the Kapiti and Athi plains; (3) a vast region covered by volcanic rocks extending across the rift-valley to the shores of the Victoria Nyanza. The succession and character of the rocks of each of these are described in detail, while subjects of more immediate interest to the geographer, such as the morphological features arising from the geology, the surface soils and water resources, are also dealt with. In the coastal belt, Mr. Muff confirmed the fact of a simple structure due to a succession of beds dipping about 10° towards the east-south-east. An interesting point brought out by the study of the shales of the foot-plateau is that the valleys in this were eroded at a time when the land stood relatively higher than at present, and that this period of elevation was subsequent to the formation of the raised coral-reef. In the second region, the bold hill ranges and isolated peaks of the gneiss are a characteristic feature, though in one or two areas the hills are volcanic. By its decomposition and disintegration the gneiss forms a widely spread, red sandy earth, often associated with limestone nodules, resembling the *kunkar* of India. Under suitable irrigation there is no doubt that the red earth would be exceedingly fertile. It is in the third or volcanic region that the morphological features are of the greatest interest, by reason of the presence in it of the rift-valley. The country on either side of this is built up of a succession of lava-flows and volcanic tuffs, which dip, like the general surface, away from the valley in both directions. Two main periods of vulcanicity can be

traced, the earlier on the whole older, the later younger, than the subsidences,* some of the eruptions having taken place in geologically recent times. Over most of the region, no formation can be traced between the gneiss and the earliest volcanic eruptions, although a vast interval must have elapsed between them. Mr. Muff describes in some detail the complex series of faults which bounds the rift-valley, especially on its eastern side. In some cases, fault-block ridges remain isolated between faults with opposite down-throws, the intervening trough-valleys being sometimes traversed by two stream courses, one at the foot of each scarp. Evidence of the extreme slowness of the subsidence which formed the rift-valley is supplied by the overflow from the Olbolosat lake, which runs through a sharp gap cut through the Laikipia scarp, having been able to cut down its channel as the scarp rose. Of the superficial deposits on the volcanic rocks, three have a wide distribution, viz. a red clay resembling laterite; a black cotton-soil; and a yellow loam found in the rift-valley, especially in the neighbourhood of Naivasha. All are alike derived from the volcanic rocks, but they have been formed under different conditions. The first, which reaches a thickness of 30 feet at the Mau escarpment, is much thinner where deforestation has taken place; and in view of the importance for agriculture of this fertile clay, Mr. Muff urges the need of measures to check this harmful practice. The black cotton-soil resembles the *regur* of peninsular India. It is characteristically treeless, and has been formed where the drainage is poor. Thus, north of Nyeri, it covers the surface of a volcanic plateau, while the sides of the valleys are coated with the red clay. The yellow loam much resembles loess, and is derived from the disintegration, rather than the decomposition, of the rocks, though it has apparently been transported by water, not by wind action. Mr. Muff assigns a recent origin to the existing Lake Naivasha, and thus accounts for its freshness. It must once have stood at a higher level, and been drained southwards by the Enjororowa valley.

Italian Somaliland Frontier.—In the March number of the *Bollettino* of the Italian Geographical Society there is reproduced a lengthy statement by Signor Tittoni, the Italian Minister of Foreign Affairs, relative to the frontier of Italian Somaliland on the side of Abyssinia. The treaty of peace concluded after the battle of Adowa in 1896, which is sometimes given as authority for the usual definition of the frontier as a line running at a distance of 180 miles from the coast, is innocent of any reference to the subject. Signor Tittoni stated that, with other frontier questions, the limitation of the Italian possessions bordering the Indian ocean was discussed between the Emperor Menelik and Major Nerazzini, acting on behalf of the Italian Government, in 1897. Menelik was ready to recognize as the boundary a line extending from the southern frontier of British Somaliland to the Juba river, parallel to the coast, and roughly at a distance of 180 miles (circa 180 miglia) from it. As thus defined on the maps employed in the negotiations the frontier joined the Juba "at the point where are marked the cataracts of Van der Decken," a little above Bardera. This arrangement left outside of the Italian zone the station of Lugh, which had been occupied by Captain Böttogo in December, 1895, but in this the Italian Government found itself forced to acquiesce (September, 1897). Since then, however, claims have repeatedly been advanced to Italian possession of Lugh, being justified apparently on the ground that since the limits of Abyssinia in 1891, as indicated by Menelik in a letter to the Powers, did not extend to Lugh, the 1897 frontier must be regarded merely as the boundary-line between Italian territory and debatable ground. Signor Tittoni announced that

* Mr. Muff does not appear to distinguish an earlier and later period of subsidence, as has been done by German observers further south (cf. *Journal*, vol. 31, p. 218).

Menelik was willing to discuss the definition of a frontier which would include Lugh within the Italian zone, but that he demanded pecuniary compensation for the abandonment of his claims. On this basis a settlement has now been arranged. Subject to the approval of the Italian Parliament, a convention concluded on May 16 by the Italian representative at Adis Abeba with the Emperor Menelik fixes the starting-point of the frontier on the Juba river at Dolo, some distance above Lugh. From Dolo, which is situated at the confluence of the Dawa river and the Ganabe Daria, the frontier is carried to the Webi Shebeli, where it joins, and follows to the frontier of British Somaliland, the line laid down in the 1897 arrangement. The same convention fixes the frontier of the Danakil country in Eritrea at a distance of 60 kilometres from the coast, while provision is made for the payment by Italy to Abyssinia of an indemnity of 3,000,000 lire (£120,000).

The Desiccation of North Central Africa.—The question whether the northern interior of Africa, especially the Sahara and neighbouring parts of the Sudan under French domination, is undergoing a process of desiccation at the present day, is discussed by M. J. Lahache in a paper printed in the *Bulletin* of the Marseilles Geographical Society (vol. 31, 1907, pp. 149-185). The author, whose remarks are generally judicious and discriminating, points out what a large body of *data* is required before we can be in a position to give a definite answer to the question, and shows what divergent views have been put forward by different observers, who have none the less had precisely the same facts before them; this being due no doubt in part to differences of temperament or point of view. Thus the confident statements of Lenfant and others regarding the drying up of Lake Chad are opposed by facts adduced by equally careful observers. Discussing the causes put forward to account for the existence of the desert, M. Lahache regards the explanation of Schirmer, based on the *régime* of the winds, as decidedly probable, though the conditions may, he considers, be more complicated than those sketched by that writer. As regards secondary causes, he lays more stress than seems justified on the effect of former rainfall in reducing the relief, and burying the surface under the resulting *débris*, thus both destroying vegetation and causing the drainage to take place beneath the surface. For no reason is given why the process of denudation should, other things being equal, operate more forcibly in the Sahara than elsewhere. Among other secondary causes, the disorganized condition of the inhabitants may be in some measure accountable. M. Lahache believes that conditions have changed for the worse since Roman times, though possibly not more than has been the case in southern Europe. On the whole, he considers that the *data* do not justify belief in a progressive desiccation at the present day, though certain regions (such, *e.g.*, as the basin of the Igharghar) have in the past suffered in an especial degree, while others have to a great extent escaped the desiccating influences. The opinions quoted by the writer show how far we still are from arriving at a unanimous verdict regarding the general character of the Sahara as a whole. This is no doubt due to the great local differences which prevail. The recent work of M. Gautier and others has supplied a useful warning against too hasty generalization regarding the desert character of the region as a whole, but there may be equal danger of a too decided reaction of opinion, based on observations in a few favoured localities. On the whole, there seems little reason to modify the opinion that vast areas of real desert exist, broken here and there by regions with more favourable conditions of relief.

The Discovery of the Ubangi.—The credit justly due to the late Mr. Grenfell for the discovery of this river having not always been assigned to him in Belgium, Sir Harry Johnston has addressed a letter on the subject to the *Mouvement Géographique*, in which it was printed on May 3 (No. 18, 1908), with

appreciatory remarks by the editor. Mr. Grenfell's journals and notes (placed in Sir H. Johnston's hands for the purposes of the memoir on which the latter has been for some time engaged) show that the first discovery of the mouth of the river was made in February, 1884, by Mr. Grenfell, who revisited the confluence in company with Mr. Comber in July of the same year, making his first ascent in the following October. The confluence was visited by the Congo State officer, Captain Hanssens, two months after its first discovery. Sir H. Johnston also makes the excellent suggestion that Grenfell's name shall be commemorated by being given to the falls of the Mobangi between Zongo and Mokoangai, and urges that the names of Schweinfurth, Junker, and others should be similarly commemorated. Without any desire to detract from the value of Mr. Grenfell's services, it may be pointed out that the Ubangi seems to have been heard of, if not seen, by Stanley on his first descent of the river, his map in 'Through the Dark Continent' showing the river Kunya as probably existing in the position of the mouth of the Ubangi, a little above a rocky point which corresponds well with that of Ngombe. His name Kunya, too, is reproduced in Nkunja, the first French post established on the lower Ubangi. The name Ubangi was applied by him to a large district west of the main river.

Dr. Pösch's Expedition to South Africa.—On his way into the interior of South-West Africa (*Journal*, vol. 30, p. 334), Dr. Pösch paid some attention to the question of the geographical conditions affecting the growth of the *Welwitschia* in the Namib desert, and the results of his observations have been communicated to the Vienna Academy of Sciences. As was shown on the sketch-map accompanying Mr. Pearson's account of his recent journey, printed last year in the *Kew Bulletin* (cf. *Journal*, March, 1908, p. 336), the occurrence of the *Welwitschia* within the German territory seems to be now limited to a tract on the lower Swakop and Khan rivers, measuring not more than 25 miles in its greatest length. One of the stations on the Windhuk railway situated within this tract has received its name from the plant, and it was hither that Dr. Pösch proceeded for the study of the plant. He found that many of the specimens had suffered much from the ravages of locusts, which had committed a surprising amount of damage, considering the toughness of the leaves. No doubt on this account, some of the plants showed no signs of flowering. Many of the specimens were growing in the slight runnels made by running water, but Dr. Pösch thinks that this is not due to the greater amount of moisture present in these (the flow of water being so rare an occurrence), but to the fact that the seeds which fall here find it easier than elsewhere to 'push down their tap-roots into the subsoil. Attempts to obtain complete specimens were rendered difficult by the great depth to which the roots penetrate, and the hard (sometimes rocky) nature of the ground. Experiments at transplanting specimens seem to have entirely failed so far, though seeds have successfully germinated. As a rule the plants grew with the upper part of their stems (which had an average diameter of 2 to 3 feet) raised above the surface, though they were sometimes covered with sand up to their leaves. Although Dr. Pösch observed flies about the male flowers, these did not seem to visit the female plants, and he thinks that the pollen is transported by the agency of the wind, a light breeze from the south-west being found to blow daily about midday during his stay. Writing in January, the traveller announced his intention of making an early start for the interior by way of Gobabis and Rietfontein.

The Comoro Islands attached to Madagascar.—By a decree dated April 9, 1908, the government hitherto known as that of Mayotte and Dependencies (which has embraced the whole Comoro group) has been placed under the supreme authority of the Governor-General of Madagascar, while retaining its administrative and

financial autonomy under a functionary appointed from the general colonial service.

AMERICA.

McLean Canyon, Hamilton River, Labrador.—By a decision of the Geographic Board of Canada, the canyon below the Grand falls of Hamilton river has been named "McLean," in honour of John McLean, an officer of the Hudson Bay Co., who discovered the falls and canyon in 1839, and gave a vivid description of them in his book entitled 'Notes of Twenty-five Years' Service in the Hudson's Bay Territory' (vol. 2, p. 75). A note on Mr. H. G. Bryant's visit to the falls appeared in the *Proceedings R.G.S.*, vol. 14, p. 49.

Geographical Influences in the Making of New Jersey.—New Jersey is a state of paradoxes and contrasts. South Jersey, or three-fifths of the state, is coastal plain, low, sandy, thickly peopled. Half of North Jersey is thin-soiled and largely "forested." Yet in the value of its farm-crops per acre, New Jersey takes the lead of all the states. For 250 miles its coast has no commercial harbour, yet New Jersey ranks among the foremost industrial states. Endowed very poorly with raw material, minerals, and water-power, its capital invested in manufacturing far exceeds that invested fifty years ago in the whole of the United States. Yielding not an ounce of copper ore, nor of coal to smelt it, the state's first manufacturing industry is copper-smelting. Yielding not a drop of petroleum, its petroleum-refining is a prominent industry. Within a few miles of one another may be admired on one hand Lakewood's sumptuous hotels, and on the other the unpainted cabins of barefooted occupants. Close by the feverish enterprise and capital of New York city stretches the pine belt, the haunt of huckleberry pickers. An article by R. H. Whitbeck in the *Journal of Geography* (vol. 6, No. 6) shows how far these and other striking contrasts are due to the state's position in the neighbourhood of a dense and wealthy urban population. The commercial incapacity of the coast constitutes its peculiar qualification as a hotel resort for the great centres of wealth in its neighbourhood. Their demand, again, for products fresh from farm and dairy has evoked a "garden state," out of a land very poorly provided agriculturally. The value to the state of its proximity to New York City is indicated by the fact that seventy per cent. of its manufacturing capital is engrossed in plants close to New York—some on the water front, all of them close to the great coal-carrying railways. A striking example of the influence of topography is to be seen in the rôle played by First mountain, though less than 400 feet high, in separating a swarming metropolitan population on the one side from a sparse farming population on the other. Summing up, the writer holds that the material growth of New Jersey is due, first and foremost, to its position between two great states, two great cities, and two great harbours.

The Lower Course of the Pilcomayo.—In the Buenos Aires *Standard* for February 21 appears the summary of a report by two young Swiss-Argentines, brothers named Adalberto and Arnaldo Schmied, describing the results of expeditions in 1906 and 1907 to the swamps of the Pilcomayo, south of the 24th parallel. In his survey of the river from its junction with the Paraguay up to 22° south, the Norwegian engineer, Mr. Gunnar Lange, only skirted this great tract of swampy country on its western side; and the German engineer, Mr. W. Herrmann, coming from the north, stopped short in his explorations at the entrance to the swamps (see *Journal*, vol. 29, p. 461). Owing to its marshy character the country is difficult of examination, but the brothers Schmied claim that they have solved its hydrographical problems, and determined the true course of the Pilcomayo through the swamps. This is still a matter of interest in the frontier relations between the

Argentine Republic and Paraguay. As now represented, the river-system south of the 24th parallel differs materially from its generally accepted character. It appears that there are three main branches—the Rio Confuso, flowing into the Paraguay river a little below Villa Hayes, and what in the present report are called the northern and southern arms of the Pilcomayo, uniting at Las Juntas just north of the 25th parallel, and thence flowing along the well-known course, agreed upon as the principal channel of the Pilcomayo, into the Paraguay river below Asuncion. The waters brought down by the Pilcomayo to Lake Chaja, at the head of the marshes, were found to flow together till divided by a strip of high land. At the point of bifurcation a deep, narrow channel led to the left to the ditches of the Rio Confuso, while the larger volume of water flowed on into the southern arm of the Pilcomayo. On a rough sketch-map representing the results of these explorations the northern arm of the Pilcomayo, flowing between the southern arm and the Rio Confuso, is shown as a much smaller stream than either of the other two, and the opinion is expressed in the report that it is mainly fed from the rainfall of the marsh. The channel connecting Lake Chaja with the southern arm of the Pilcomayo is in places somewhat ill defined and choked with rushes, but it is regarded by the brothers Schmeid as unmistakably the natural course of the Pilcomayo, and they believe that by clearing away the rushes much of the wastage of waters in the marshlands would be saved and a practicable if provisional waterway would be established, opening up a new line of communications with the southern provinces of Bolivia. The stream designated the southern arm of the Pilcomayo, and identified by the Argentine explorers as the main branch of the river, appears to be that shown by Stieler as the Rio del Instituto Geographico. Stieler, however, though showing it as a southern (or western) loop, makes the northern (or eastern) loop the main river and the frontier between the Argentine Republic and Paraguay; so that if the brothers Schmied are correct, their report is of considerable importance.

GENERAL.

The Ninth International Geographical Congress.—A 'Livret des Excursions' has been issued in connection with the approaching Congress at Geneva, supplying not only the programmes of the excursions, but an instructive commentary on the scientific lessons to be gained from them. It may be obtained, at the price of 1.50 fr., from Prof. E. Chaix, 23 Avenue du Mail, Geneva. Those wishing to take part in the excursions are reminded that the latest date on which applications can be received is July 1. This applies to the excursions after the meeting, the latest date for those preceding it being June 1.

Course of Oceanography at Bergen.—We are informed that a course of instruction in Oceanography, embracing the various branches of the subject, will again be held this year at Bergen, between August 10 and October 15. The fee charged is about £8, and those wishing to attend the course are directed to apply, before July 1, to the Oceanographical Institute of the Bergen Museum.

Geographical Field Study under Prof. Davis.—Prof. Davis announces his intention of spending June and the greater part of July of this year in northern Italy and the Alps, studying certain geographical problems. Among the districts which it is proposed to visit the following are mentioned: The north-eastern foothills of the Apennines near Ancona; the non-glaciated valleys of the north-east Apennines near Faenza; the basin of Florence; portions of the Mediterranean coast; various parts of the Po basin; and various types of valleys in the Italian and French Alps and the Cevennes. In each case the lessons to be learnt regarding the evolution and physical relations of the existing surface forms will be

studied. Prof. Davis would be pleased to have associated with him a number of advanced students, already somewhat practised in field study. The party may be joined and left at any time, as desired, each member making his own travelling arrangements, and paying his own expenses, although, while the party is together, it is expected that plans will be made in common. A general reunion is proposed, about July 18, in or near Grenoble, for the presentation and discussion of the various studies. Prof. Davis may be addressed c/o Kusten & Co., Turin, until June 30. A statement of qualifications or letter of introduction should be sent to him by those desirous of joining the party.

Lectureship in Geography at Glasgow University.—We are pleased to learn that the Court of Glasgow University has decided to establish a lectureship in geography, thus adding another to the encouraging signs of the interest which the subject is now attracting in educational circles.

The Oxford School of Geography.—Mr. H. O. Beckit, M.A., Balliol College, has been appointed assistant to the Reader in Geography at Oxford for the year 1908-9. Mr. Beckit has been assisting Dr. A. Strahan, F.R.S., in the work of the River Investigation Committee in the Exe basin.

OBITUARY.

**Colonel A. W. Baird, R.E., C.S.I., F.R.S., and
Colonel H. F. Blair, R.E.**

QUICKLY following in the footsteps of Sir Richard Strachey, two of his brother officers in the Royal Engineers, members of the Royal Geographical Society, have also passed across the borderland which separates the known from the great unknown.

First to cross was Colonel A. W. Baird, who died on April 2. Colonel Baird served most of his time in India, where, as a member of the scientific branch of the Survey Department, he was one of the first to investigate the problems of tidal movement, and to reduce to a system the complicated series of observations which were necessary in order to determine tidal action, and to solve the intricate problems surrounding mean sea-level. Under his guidance as executive officer, stations of observation were founded on Asiatic shores from the Bay of Bengal to the Mediterranean, and a system of registration inaugurated which furnishes the mass of data on which we base predictions. Colonel Baird had, at least, the satisfaction of seeing tidal observation recognized as a most important branch of the scientific investigations undertaken by the Survey of India. To considerable mathematical ability he added the gift of conscientious thoroughness in every detail of his work, and he well earned the distinction conferred on him when he was elected to a fellowship of the Royal Society. During the later years of his Indian career he held the important post of mint-master in Calcutta, and his services in that capacity earned him the distinction of Companionship of the Star of India, and the direct and formal recognition of the Government.

After more than thirty-seven years of active work, dating from his first commission in December, 1861, Colonel Baird retired to his pretty Scotch home, near Elgin, and there he continued to take a keen and lively interest in all around him until declining health warned him of the necessity for rest. He died very suddenly whilst under medical advice in London.

Colonel H. F. Blair belonged to the earlier school of Addiscombe, and, like

Strachey, was a member of that distinguished body of public servants—the Bengal Engineers—under the old company's *régime*. "Tooney" Blair may be said to have made his mark from the very commencement of his career. Blessed with a sound physique and strong vitality, he was always to the front in any college enterprise. He obtained his commission in June, 1856, and his first active service in India was in the Ambeyla campaign, where he distinguished himself by an almost too prominent activity in face of the enemy. Probably few men on the Indian frontier had such an intimate knowledge of the tribes-people of the Afridi border, or made such excellent use of them. Under Blair, the Zakka Khel were a hard-working and peaceable folk, who made roads and dug ditches with all the fervour of reformed navvies.

It was his remarkable personality (as it was with Sir Robert Sandeman or Sir James Browne) which won him, not merely the respect, but the implicit obedience of all these unruly border people. During the Afghan war of 1878–80, he soldiered with the Khaibar force, and it was then that his exceptional capacity for rapid field engineering proved so practically valuable. He retired soon after the war in 1883, and lived chiefly in London, where his keen intellect and sound technical ability have ever been at the service of the public in municipal and civil administrative work—even after the terrible affliction of blindness had befallen him. Then, perhaps, in the darkness of his daily life, was his courage and resolution most severely tried. Yet they never failed him. His home was still the home of his many frontier friends, and his cheery welcome was for them all. Always keenly interested in geographical enterprise, it almost seemed as if the map of the world was graven on his memory; so that men, discussing with him the prospects of the world's new ways, forgot that they were talking to one who could no longer see. Undistinguished by stars and ribbons, it may well be doubted whether any finer soldier ever trod the rocky soil of the Indian frontier than Henry Francis Blair. He died on April 15, at the age of 71.

T. H. H.

CORRESPONDENCE.

The Mapping of Lake Chad.

MR. BOYD ALEXANDER, in his book published in 1907, 'From the Niger to the Nile,' puts forward the following claim: "To sum up as shortly as possible the scientific results of the expedition. . . . Secondly, the exploration and mapping of Lake Chad, which has considerably altered the idea previously held of that region, and has made the lake into two."*

Sir Harry Johnston, in his review of Mr. Alexander's work in the *Geographical Journal* of February, 1908, writes, "Barth and Nachtigal added somewhat to our knowledge of the countries round this sheet of water, but so far as actual survey work went, it was never entitled to more than a dotted outline until this last expedition undertaken by the two Alexanders and their companions, Goelling and Talbot."

In the *Geographical Journal* for March, 1908, A. K. gives a brief account of the sources of our information with regard to Lake Chad, pointing out that "it is to the French officers that we owe, almost entirely, our present knowledge."

The statement of A. K. appears to the present writer to be strictly accurate. It is not possible to allow the justice of the claim made by Mr. Alexander and supported by Sir Harry Johnston.

* Vol. 2, pp. 375, 376.

I must ask leave to quote a portion of an article by M. André Meyreuil in the March number of the *Bulletin du Comité de l'Afrique Française*, in which reference is made to Sir Harry Johnston's remark quoted above: "En tout cas, pour M. Johnston, le principal résultat des efforts de ses vaillants compatriotes résiderait dans l'étude qu'ils ont faite du Tchad qui ne fut, ajoute-t-il, jamais représenté par autre chose qu'un pointillé jusqu'à leur arrivée sur ses bords.

"Il est à peine besoin devant les lecteurs du *Bulletin* de relever ce qu'il y a d'inexact dans une pareille affirmation. Il n'est possible, en effet, de la formuler qu'à la condition d'oublier complètement les travaux pourtant si nombreux et si complets de nos officiers et de nos fonctionnaires du Chari. Comment ne s'étonnerait-on pas de constater qu'un écrivain aussi avisé que M. Johnston ignore que depuis que Gentil fit flotter sur le Tchad le premier bateau à vapeur en 1897, jusqu'à l'apparition de la belle carte du Capitaine Tilho, en 1906, dans la *Géographie*, il ne s'est pour ainsi dire pas passé une année où n'ait été publiée dans les revues françaises quelque étude sur le lac fameux. . . ."

If any one questions the facts that not only were the French the first to make a satisfactory map of Lake Chad, but that they did it with a thoroughness and an accuracy which relegate all other mapping of the lake, which has been hitherto carried out, to a secondary position, he should read Captain Tilho's article on the exploration of Lake Chad in *La Géographie* of March, 1906, and study the excellent map which accompanies that article.

A. K.'s note elicited from Sir Harry Johnston and Mr. Alexander letters which appeared in the April issue of the *Geographical Journal*. I hope that the former will forgive me if I say that a clear inference to be drawn from his letter is that up to the time of writing it he had not seen the above-quoted number of *La Géographie*.

C. F. CLOSE.

NOTE.—Mr. Alexander reminds us that three latitudes were taken by Mr. Talbot in the northern portion of the lake, and mentions "the astronomical determining of the position of Kaddai." The latter expression would seem to include the determination of longitude, but this is not mentioned in the note on his map. For the construction of the French map, showing the state of Chad at the end of April, 1904, thirteen positions on or near the shore of the lake were fixed in latitude, the longitudes of four of these were determined by occultations, and of nine by transport of chronometers. Mr. Alexander adjusted his traverses on four of these positions determined by Captain Tilho, and has acknowledged the fact on his map. An inset to Mr. Alexander's map shows the "shore-line formerly determined," and the outline of this appears to be based on Captain Tilho's map of 1906, which is of a far more detailed character than that of Mr. Alexander.

May 15, 1903.

May I ask Major Close to refer to the War Office Map, October, 1905, General Staff, No. 2077, on which our "additional route," to use A. K.'s description, in the northern half of the lake appears for the first time? If Major Close will study the "route" carefully, he will see that it follows a shore-line determined by us, which greatly reduces the previously accepted size of the northern portion. Moreover, our observations proved that the lake is divided into two, and my statement to that effect was published in the *Geographical Journal* of November, 1905.

The altered idea of the lake shown by the French in their map, published in *La Géographie*, March, 1906, goes a good way to bear me out, though they do not completely separate the two parts, but show a passage between.

I still hold to my statement that the lake is divided into two, and in view of this fact and of the alteration made by us in the north-eastern shore-line, I see no reason why I should depart from my words which said that the work of our expedition "has considerably altered the ideas previously held of the region, and has made the lake into two."

I am not so ill content that Major Close should keep "A. K." company; while I am proud to know that the honour which the Royal Geographical Society is giving this year in recognition of the work of our expedition, is identified by that body with our record on Lake Chad.

Kaddai was longitudinally determined by sextant observations.

BOYD ALEXANDER.

The Question of Mr. Johnson's High Camp.

In some remarks in the March *Geographical Journal*, p. 345, under the title of "Mr. Johnson's Ascent of E 61," Dr. Longstaff says a statement of mine, made in reply to an incorrect statement of his in the *Journal* of January, 1908, "ought not to pass unnoticed."

I would call Dr. Longstaff's attention to the desirability, when criticizing the statements of others, of defining his own position with more precision than he has done in this case. On p. 41 of the *Geographical Journal* of January, 1908, he states, as he has elsewhere stated, that Mr. Johnson "spent a night at over 22,000 feet in the Kuen Lun when surveying beyond the Changchenmo in 1864." It was to this statement that the passage criticized referred, which was intended to show the improbability of a high camp, such as Dr. Longstaff alleges, having been made in this region or district.

On p. 345 of the March *Journal*, Dr. Longstaff again says, "Johnson's high camp was made in 1864, on his way to the Yarkand road from the neighbourhood of the Shayok river," and adds that "he ascended E 61 many miles to the east in 1865." It will be noted that E 61 stands in the region in which Dr. Longstaff says the high camp was made in 1864. To this second statement the passage criticized did not refer.

To which of these statements is one to understand that Dr. Longstaff adheres? The two regions mentioned are, as he points out, a considerable distance apart, and quite different in character, the latter being far more inaccessible, and its mountains higher. It is evident that Mr. Johnson could not have made the high camp in both regions at the same time.

Now, the only thing connected with Mr. Johnson's explorations that my paper concerned itself with was the question whether Mr. Johnson claimed to have camped at over 22,000 feet, and, if so, where this claim is recorded. Dr. Longstaff asserts as a fact that he camped at this altitude, and gives several references, presumably in support of this assertion, in three of which, containing accounts of Mr. Johnson's explorations, I was unable, as I stated, to find any mention of such a camp.

The identity of E 61 with K₂, or the "Muztagh," and Mr. Johnson's building of "masonry platforms" at 21,500 feet are interesting items, but they throw no light on the question at issue.

If I have overlooked Mr. Johnson's statement of his claim, or if Dr. Longstaff thinks I am in error in declining to accept his own statement as to the camp in question without adequate evidence, it is a simple matter for him to point out where Mr. Johnson's claim (not that of other persons for him) can be found, and describe the method he employed to determine the altitude of the camp, so that an

opinion may be formed as to the correctness of his conclusion. In doing this it is not necessary to cite any of his collateral achievements.

WILLIAM HUNTER WORKMAN.

Lucknow, March 31, 1908.

Surface Forms in Western South America.

Northwood, Middlesex, April 20, 1908.

In the April *Journal* appears some interesting matter relative to snow-formations, or *nieve penitente*, also sand-dunes. The west side of South America offers—especially in Peru—an exceptionally interesting field for the observance of desert and mountain phenomena, especially those induced by æolian action and peculiar climatic conditions. As regards the pillars, or *penitentes*, as they have been fancifully termed, they are not confined to snow, but in the foothills of the western Andine desert region are to be seen in earth, and might be called *tierras penitentes* with equal reason.* I have observed singular pillars of this nature here, generally consisting of a tapering cone of soil capped at the top by a large pebble, or even a rock. I have also noted similar but much smaller structures on the plateau of Anahuac, Mexico. The surrounding level has, of course, been worn down by the action of wind, sun, and rain (although parts of these regions are rainless); the stone forming a sheltering and consolidating covering. In the Chilean Andes of Tarapacá there exists in a certain place some remarkable series of pillars of earthy mud, formed by disintegrated rock. These strange pillars, which look like groups of statuary, often are of 10 to 30 feet in height, formed of material impregnated with sulphate of lime. During the day and under the heat of the sun they become soft and with a muddy-appearing surface, but at night become exceedingly hard, like frozen mud—the effect of temperature upon the sulphate of lime which they contain. The elevation is more than 14,000 feet. In the Peruvian Andes very remarkable gravel and conglomerate pillars are encountered at high elevations of the most weird forms, also due in some cases to action brought about by mineral impregnation.

A word as to sand-dunes. The coast plains of Peru and Northern Chile form an absolutely rainless region, and here æolian action plays strange pranks with the fine drifting sand. I have observed the singular *médanos*, or travelling crescent-shaped dunes, here in a most perfect form, especially near Camaná and on the deserts west of Arequipa. I made careful observations of some of these dunes, with measurements, but at the moment have not my notebook at hand. I observed an "army" of hundreds of them in their slow movement across the plain. Of course, the movement is not visible without close observation, and depends upon the force of the wind. It might amount to 1 or 2 feet in an hour when the breeze blows briskly. On the sea verge I observed them being "born"; that is, they evolved out of a bank of fine dry sand, took their characteristic crescent form on a flat upper beach, and were strung out away inland, all of similar shape and proportion, but of varying sizes. The æolian ripples on their backs—which, of course, is the cause of movement by the constant changing of place of the particles—reminded me of the quivering of the skin of an animal. I have spoken of these dunes and the region generally in a recent book—the 'Andes and the Amazon.'

C. REGINALD ENOCK.

* The parallelism between the *penitentes* and the well-known earth-pyramids has also been suggested by Dr. S. Günther (cf. *Journal*, vol. 28, p. 91).

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907-1908.

Twelfth Meeting, April 13, 1908. The Right Hon. Sir GEORGE T.

GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*George Bailey Beak, M.A.; Rev. James Redgate Brown; Haigh Clapham; Nugent Medd Cougher; Lieut.-Colonel H. S. Davies; Rev. Thomas Davis; George Victor Septimus Dunn; Major the Hon. Algernon Hanbury-Tracey, R.H.G., C.M.G.; Otto Honigman; Leonard Vullance Lees; George Lynch; Captain J. H. Mathews (5th Fusiliers); James William Miller, M.A.; Lieut. Henry Gibbon Moore, R.G.A.; Lord William Percy; John S. du Plessis; José Maria Rivas-Groot; Couper Frederick Wollaston Rochfort; Thomas Frank Southam, M.D.; Lieut. W. R. Thompson, R.G.A.; Francisco José Urrutia; John Baxter Wyles.*

HONORARY CORRESPONDING MEMBERS.

Dr. A. V. Grigoriev, for many years Secretary Russian Geographical Society; Prof. Dr. G. Hellmann, Director Royal Meteorological Institute, President Berlin Geographical Society.

The paper read was :—

"Explorations on and around Prince Charles Foreland, Spitsbergen." By Dr. W. S. Bruce.

Thirteenth Meeting, May 11, 1908.—The Right Hon. Sir GEORGE T.

GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*Matthew Cameron Blair; Norman Ferütua Brander; George W. H. Burton; Peter Henry Clutterbuck; Robert Gordon Finlayson; Frederick Beckles Gall; Rev. William Gilchrist; Gideon Gledhill; George Moss Lloyd, M.A.; William Clements Logan; Edward Francis Southan Newman; Edmund R. Newman; Captain Ffordr Searight (Dragoon Guards); Jose Sebastiao Guilherine Leao de Muller e Sousa.*

The paper read was :—

"Geographical Conditions and Railway Construction in the Balkan Peninsula." By Noel E. Buxton.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., Librarian, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full :—

No. VI.—JUNE, 1908.

3 A

A. = Academy, Académie, Akademi.
 Abh. = Abhandlungen.
 Ann. = Annales, Annales, Annalen.
 B. = Bulletin, Bollettino, Boletim.
 Col. = Colonies.
 Com. = Commerce.
 C.R. = Comptes Rendus.
 E. = Erdkunde.
 G. = Geography, Géographie, Geografia.
 Ges. = Gesellschaft.
 I. = Institute, Institution.
 Is. = Ivestiya.
 J. = Journal.
 Jb. = Jahrbuch.
 k.k. = kaiserlich und königlich.
 M. = Mitteilungen.

Mag. = Magazine.
 Mem. (Mém.) = Memoirs, Mémoires.
 Met. (mét.) = Meteorological.
 P. = Proceedings.
 R. = Royal.
 Rev. (Riv.) = Review, Revue, Rivista.
 S. = Society, Société, Selskab.
 Sc. = Science(s).
 Sitzb. = Sitzungsbericht.
 T. = Transactions.
 Ts. = Tijdschrift, Tidskrift.
 V. = Verein.
 Verh. = Verhandlungen.
 W. = Wissenschaft, and compounds.
 Z. = Zeitschrift.
 Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 x 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

- Faroës—Phytogeography.** Ostenfeld.
 The land-vegetation of the Færøes, with special reference to the higher plants. By C. H. Ostenfeld. (Reprinted from 'The Botany of the Færøes,' part iii.) Copenhagen, 1908. Size 10 x 6½, pp. 865-1026. *Illustrations. Presented by the Author.*
- France—Corsica.** Schibler.
Jahrbuch Schweizer-Alpenclub 41 (1905-6): 244-267; 42 (1906-7): 291-311.
 In Korsika. Von Dr. Wilh. Schibler. *Illustrations.*
- France—Hérault.** Berthelö.
B.S. Languedoc. G. 30 (1907): 87-99.
 Une nouvelle hypothèse sur l'origine du nom de Montpellier. Par Jom. Berthelö.
- France—Historical.** Jefferson.
J.G., New York 6 (1907): 113-117.
 Cæsar and the Central Plateau of France. By Mark S. W. Jefferson. *Sketch-map.*
 Traces the influence of geography on Cæsar's campaigns.
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Das Schöpfungsproblem gelöst? Von H. Habenicht. (Aus der Zeitschrift "Glauben und Wissen," 1908, Heft 3.) Size $9\frac{1}{2} \times 7$, pp. 10. *Presented by the Author.*

Geomorphology—Erosion. *Rev. G. Annuelle* 1 (1906-07): 281-308.**Brunhes.**

Erosion fluviale et érosion glaciaire: observations de morphologie comparée. Par Jean Brunhes. *Illustrations and Sketch-maps.*

The author here elaborates the ideas put forward in a note referred to in the *Journal* for July, 1907, p. 95. (See also May number, ante, p. 569.)

Geophysics.*G.Z.* 14 (1908): 13-20.**Hecker.**

Der Aufbau der Erdkruste in mathematische-physikalischer Hinsicht. Von O. Hecker.

Geophysics.*Science* 27 (1908): 227-233.**Becker.**

Age of a cooling globe in which the initial temperature increases directly as the distance from the surface. By Dr. George F. Becker. *Diagram.*

Meteorology—Air-currents.**Trowbridge.***Monthly Weather Rev., Washington* 35 (1907): 390-397.

On atmospheric currents at very great altitudes. By Prof. C. C. Trowbridge. *Diagrams.*

Based on a study of the trains left by large meteors.

Phytogeography.**Bower.**

The origin of a land flora: a theory based upon the facts of alternation. By Dr. F. O. Bower. London: Macmillan & Co., 1908. Size 9×6 , pp. xii. and 728. *Illustrations.* Price 18s. net. *Presented by the Publishers.*

An investigation of the possible mode of evolution of land vegetation in general, with little or no reference to geographical relations.

Seismology.**Hobbs.**

Earthquakes: an introduction to seismic geology. By William Herbert Hobbs. London: S. Appleton, 1908. Size 8×5 , pp. xxxii. and 338. *Maps, Illustrations, and Diagrams.* Price 8s. net. *Presented by the Publisher.*

Identical with the American edition reviewed in the April number (p. 433).

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

- Anthropogeography.** *G.Z.* 13 (1907): 401-425. **Hettner.**
Die Geographie des Menschen. Von Alfred Hettner.
- Anthropology.** **Fraser.**
Questions on the customs, beliefs, and languages of savages. By J. G. Fraser. Cambridge: University Press, 1907. Size 6½ x 4, pp. 52. *Presented by the Publishers.*
 A valuable aid to travellers desirous of studying uncivilized peoples. Copies may be had at the Society.
- Anthropology.** **Keane.**
The world's peoples: a popular account of their bodily and mental characters, beliefs, traditions, political, and social institutions. By Dr. A. H. Keane. London: Hutchinson & Co., 1908. Size 8 x 5½, pp. xii. and 434. *Illustrations.* Price 6s. net. *Presented by the Publishers.*
- Commercial.** **Deekert.**
Grundzüge der Handels- und Verkehrsgeographie. Von Prof. Dr. Emil Deekert. Vierte Auflage. Leipzig: Carl Ernst Poeschel, 1908. Size 8½ x 5½, pp. x. and 390. *Presented by the Author.*
- Commercial Geography.** *J.G., New York* 6 (1907): 122-128. **Hutchinson.**
 A plea for a broader conception of economic geography. By Lincoln Hutchinson.
- Commercial—Inland Navigation.** *G.Z.* 14 (1908): 20-39. **Dix.**
Deutsche Flussschiffahrt in fremden Ertteilen. Von Arthur Dix.
- Economic—Reclamation.** *B.G.S. Philadelphia* 5 (1907): 12-23. **Harshberger.**
The reclamation and cultivation of salt marshes and deserts. By Dr. John W. Harshberger. *Illustrations.*
- Ethnology—Folk-lore.** **Gomme.**
Folk-lore as an historical science. By George Laurence Gomme. London: Methuen & Co., 1908. Size 9 x 5½, pp. xvi. and 372. *Illustrations.* Price 7s. 6d. net. *Presented by the Publishers.*
- Historical—Columbus.** *Smithsonian Misc. Coll.* 48 (1907): 428-457. **Chance.**
The letter of Dr. Diego Alvarez Chance, dated 1494, relating to the second voyage of Columbus to America . . . (Translated, with notes, by A. M. Fernandez de Ybarra). Facsimile Maps.
 Written from Hispaniola to the Municipal Council of Seville.
- Historical—Fu-sang.** *J.G., Tokyo G.S.* 19 (1907): 607-625. **Shiratori.**
(On the land Fu-sang. By Kurakichi Shiratori. [In Japanese.]
- Historical Geography.** **Reclus.**
Elisée Reclus. L'homme et la terre. Vols. 3 and 4. Paris: Librairie Universelle (1905). Size 11 x 8½, pp. (vol. 3) 640; (vol. 4) 652. *Maps and Illustrations.* Price 20 fr. per vol. *Presented by M. Paul Reclus.*

BIOGEOGRAPHY.

- Bezd.** **Hellmann.**
Wilhelm von Bezold. Gedächtnisrede . . . von G. Hellmann. [Issued as supplement to the *Meteorologische Zeitschrift*, xxiv. Band, 7. Heft.] Brunswick, 1907. Size 9 x 6, pp. 32.
- Budgett.** **Shipley.**
John Samuel Budgett. Biographical sketch by Arthur E. Shipley. (Reprinted from the Volume of Scientific Papers published as a Memorial of the late J. S. Budgett.) [Cambridge, 1906.] Size 11 x 9, pp. 56. *Portrait.* *Presented by the Author.*
 The late Mr. Budgett is well known for his biological research in Africa and elsewhere.
- Etzlaub.** *Deutsche G. Blätter* 30 (1907): 55-77. **Wolkenhauer.**
Der Nürnberger Kartograph Erhard Etzlaub. Von Dr. Aug. Wolkenhauer.
 Etzlaub, about whom little has hitherto been known, was the author of some of the earliest modern maps of Germany or portions of it.

Hellprin.*B.S.G. Philadelphia 6 (1908): 1-30.*Addresses delivered at the meeting held in honour of the memory of Prof. Angelo Hellprin. *Portrait.*

Addresses by a number of speakers on various aspects of Hellprin's life-work.

Stow.**Young.**The life and work of George William Stow, South African geologist and ethnologist. By Robert B. Young. London: Longmans, Green, & Co., 1908. Size $7\frac{1}{2} \times 5$, pp. vi. and 124. *Portrait.* Price 3s. 6d. Presented by the Publishers.Stow is best known for the posthumous work on the natives of South Africa, reviewed in the *Journal* for December, 1905 (p. 661).**GENERAL.****British Empire.****Le Couteur.**The great outposts of the Empire. By Wilson Le Couteur. London, 1907. Size $7\frac{1}{2} \times 4\frac{1}{2}$, pp. 224. *Map and illustrations.* Presented by Messrs. Houlder Bros. & Co. (*Federal-Houlder-Shire Line*). [See p. 670, ante.]**Cosmogony.****Nölke.**Das Problem der Entwicklung unseres Planetensystems. Aufstellung einer neuen Theorie nach vorhergehender Kritik der Theorien von Pönt, Laplace, Poincaré, Moulton, Arrhenius u. a. Von Dr. Friedrich Nölke. Berlin: J. Springer, 1908. Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. xii. and 216. Price 6m. Presented by the Publisher.**Educational—Text-book.****Young.**A rational geography. By Ernest Young. Part ii. London: G. Philip & Son, 1908. Size $7\frac{1}{2} \times 5$, pp. xvi. and 208. *Sketch-maps and Diagrams.* Price 1s. 6d. Presented by the Publishers.

See review of Part i. in the April number, p. 437.

Educational—Text-book.**Stephenson.**The elements of geography. By J. H. N. Stephenson. Part i. General geography. London: E. Stanford, 1908. Size $7\frac{1}{2} \times 5$, pp. xiv. and 160. *Maps and Diagrams.* Price 3s. 6d. Presented by the Publisher.**Hints to Travellers.****Holding.**The camper's handbook. By T. H. Holding. London: Simpkin & Co., 1908. Size $7\frac{1}{2} \times 5$, pp. 412. *Illustrations.* Price 5s. net. Presented by the Publishers.**Hints to Travellers.****Stewart.**Active service pocket-book. By Bertrand Stewart. Third edition. London: W. Clowes & Sons, [not dated; 1907]. Size $5\frac{1}{2} \times 4$, pp. xxxii. and 940. *Diagrams and Illustrations.* Price 4s. net. Two copies, presented by the Author and Publishers. [See May number, p. 561.]**Oceanic islands.****Nicoll.**Three voyages of a naturalist, being an account of many little-known islands in three oceans visited by the *Valhalla*, R.Y.S. By M. J. Nicoll, with an introduction by the Rt Hon. the Earl of Crawford. London: Witherby & Co., 1908. Size 9×6 , pp. xxvi. and 246. *Sketch-maps and Illustrations.* Price 7s. 6d. net. Presented by the Publishers. [To be reviewed.]**NEW MAPS.**By E. A. REEVES, *Map Curator*, R.G.S.**EUROPE.****England and Wales.****Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from April 1 to 30, 1908.

1-inch (third edition):—

In outline, 99, 143, 144, 292, 293. 1s. each (engraved).

6-inch—County Maps:—

Cornwall (First Revision), 84 N.W., N.E., 42 S.E., 47 S.W., 57 N.W., 59 N.W., N.E., (59 S.E. and 60 S.W.), 65 S.E., (66 N.E., S.E., and 66a N.W.), 66 S.W., (68a N.W., 66 N.E. and S.E.), 81 N.E., S.W., S.E., 84 N.E. **Kent** (Second Revision), 23 (N.W. and S.W.), 25 N.E., 35 N.E., 38 N.W., 47 N.E., 57 S.W., 75 S.W. **Lincolnshire** (First Revision), 9 S.W., 10 N.W., 11 N.E., S.E., 13 S.E., 14 S.W., 21 S.W. **Pembrokeshire** (First Revision), 10 N.W., S.W., 15 S.E., 21 N.E., S.E., 22 N.E., S.W., 85 N.E., S.E. **Yorkshire** (First Revision of 1891 Survey), 236 S.W., 245 N.E., S.E., 246 N.E., 247 N.W., 259 S.E., 266 N.E. 1s. each.

25-inch—County Maps:—

Cornwall (First Revision), LXX. 13; LXXIII. 7, 8, 9; LXXIV. 1, 2, 4, 5, 6, 8, 9, 10, 14; LXXV. 1, 2, 5, 7, 9, 16; LXXVI. 1, 5, 9, 13; LXXXII. (10 and 6), 11, 13, 14, 15, 16; LXXXVII. 2, 7, 10, 11, 12, 14, 15; LXXXIX. 2. **Hampshire** (Second Revision), XCIII. 6. **Kent**, LXXI. 16. **Lancashire** (First Revision of 1891 Survey), C. 11, 12, 13, 14, 15; CIV. 13, 16; CVII. 1, 2, 3, 5. **Pembrokeshire** (First Revision), XXXIII. 15; XXXIX. 15, 16; XL. 13, 14. **Yorkshire** (First Revision of 1891 Survey), CCIII. 1; CCV. 8, 9, 10, 13, 14, 15; CCVI. 14; CCXVI. 11; CCXIX. 12; CCXX. 4; CCXXXI. 1, 3; CCXXXIII. 5, 6. 3s. each.

(E. Stanford, London Agent.)

England—River Thames.

Bartholomew.

Bartholomew's "Half-inch to mile" map of the river Thames from its source to the sea. Scale 1: 126,720 or 1 inch to 2 stat. miles. Edinburgh: John Bartholomew & Co., [1908]. Price, mounted in cloth, 2s. net. Presented by the Publisher.

Germany.

Oestreich.

Plötzau Ablagerungen in der Eifel und am Mittelrhein. Von Dr. K. Oestreich. Scale 1: 500,000 or 1 inch to 7.9 stat. miles. *Petermanns Mitteilungen*, Jahrgang, 1908, Tafel 8. Gotha: Justus Perthes, 1908. Presented by the Publisher.

Germany.

Rauff.

Höhenschichtenkarte der Eifel auf Grundlage der von der Königl. Preuss. Landesaufnahme herausgegeben topographischen Uebersichtskarte des Deutschen Reiches von Dr. H. Rauff. Scale 1: 200,000 or 1 inch to 3.2 stat. miles. Bonn: Friedrich Cohen, [1908]. Price 3m. Presented by the Publisher.

Basing his map upon the sheets of the German government survey, Dr. H. Rauff shows the height of land by contours and colour-tinting from sea-level to 750 metres, at intervals of 50 metres. The map is full of topographical detail, and yet is remarkably clear and legible, owing chiefly to careful execution. There are altogether fifteen contours used for indicating the heights, and this is probably the reason for choosing different colours, instead of selecting tints of the same colour, which would have been more satisfactory. The abrupt changes from green to brown which occur at 200 metres, and from brown to purple at 450 metres, are objectionable, as they suggest corresponding abrupt changes in the natural features at these points, which of course do not exist. The stereoscopic system of tinting occasionally used would perhaps have been more consistent and reasonable, and might, with care in the selection of tints, have given sufficient scope. Still, this is really a good general map of the Eifel district, and one which should fulfil the double purpose for which it has been published—of providing a useful map for the tourist, as well as one that will be of sufficient accuracy to be of service to geologists and other scientific specialists. An explanatory pamphlet of eight pages accompanies the map.

ASIA.**Indian Government Surveys.**

Surveyor-General of India.

India and adjacent countries, scale 1: 1,000,000. Sheet 78, 1907.—Levels in Sind, scale 1 inch to 2 miles. Sheets: 42, parts of districts Larkhana, Hyderabad, Sukkur, and Khairpur State, 1907; 43, district Hyderabad and Khairpur State, 1907; 46, districts Karachi, Hyderabad, and Thar and Parkar, 1907; 48, districts Karachi and Hyderabad, 1907; 70, districts Hyderabad and Thar and Parkar, 1907.—Northern Trans-Frontier Survey, scale 1 inch to 2 miles. Sheet 39, part of Kashmir, 1907.—North-Western Trans-Frontier Survey, scale 1 inch to 4 miles. Sheet 21 S.W., part of Afghanistan, 1907.—North-Western Trans-Frontier Survey, scale 1 inch to 2 miles. Sheets: 381, parts of Las Bela State and Jhulawan, Kalat State (Baluchistan), 1907; 439, parts of Afghanistan and

Waziristan, 1907; 440, parts of Afghanistan, district Zhob (Baluchistan), and Waziristan (N.W.F. Province), 1907; 448, parts of Waziristan and Bannu district, 1907; 449, parts of Afghanistan and district Zhob (Baluchistan), 1907.—South-Eastern Frontier Survey, scale 1 inch to 8 miles. Sheet 7, parts of districts Toung-ngu, Amherst, Salwin, Tharawaddi, Pyapun, Hantawaddi, and Thatun (Burma), and of the Kingdom of Siam, 1907.—South-Eastern Frontier Survey, scale 1 inch to 4 miles. Sheet 4 n.w., parts of districts Katha, Bhamo, Shwebo, Ruby Mines, and Northern Shan States (Burma), and Mongmao (China), 1907.—Bengal, scale 1 inch to 4 miles, district Shahabad; scale 1 inch to 8 miles, districts Manbhum and Monghyr, 1907.—Bengal and Central Provinces Survey, scale 1 inch to 1 mile. Sheets: 64-m, 10 and 14, parts of district Palamau (Bengal), and Sarguja State (C.P.), 1907; 73-n, 8 and 7, part of district Midnapur, 1907; 73-i, 2 and 6, parts of districts Manbhum and Hazaribagh, 1907; 73-j, 1 and 5, parts of districts Manbhum and Singhbhum, 1907; 73-m, 10 and 14, parts of districts Birbhum and Burdwan, 1907.—Eastern Bengal and Assam Survey, scale 1 inch to 1 mile, Sheets 78 v, 12 and 16, parts of districts Bajshahi (Eastern Bengal and Assam), Murshidabad and Nadia (Bengal), 1907.—Bombay Survey, scale 1 inch to 1 mile. Sheets 47-r, 4 and 8, parts of districts Thana and Kolaba, 1907; 47-j, 4 and 8, parts of districts Poona and Satara, 1907.—Burma Survey, scale 1 inch to 1 mile. Sheets: 84-n, 3 and 7, parts of districts Lower Chindwin and Shwebo, 1907; 85-r, 1 and 5, districts Bassein, Myaungmya, and Maubin, 1907; 85-r, 10 and 14, parts of districts Hantawaddi, Maubin, Myaungmya, and Pyapun, 1907; 85-r, 12 and 16, part of district Pyawun, 1907; 94-b, 1 and 5, part of district Taung-ngu, 1907; 94-n, 9 and 13, 94-o, 12 and 16, part of district Thaton, 1907; 94-n, 10 and 14, 94-n, 11 and 15, parts of districts Thaton and Amherst, 1907.—Burma, scale 1 inch to 4 miles. Sheet 93n, part of South Shan States, 1907.—Central India and Rajputana Survey, scale 1 inch to 1 mile. Sheets 55-e, 2 and 6, parts of States Bhopal, Rajgarh, Narsinghgarh, and Gwalior (C.I. Agency), 1907.—Central Provinces Survey, scale 1 inch to 1 mile. Sheets 55-i, 9 and 13, part of district Saugor, 1907; 64-o, 9 and 13, part of districts Sambalpur and Gangpur State (Bengal), and Bilaspur district and Raigarh State (C.P.), 1907.—Punjab Survey, scale 1 inch to 1 mile. Sheets: 44-o, 1 and 5, parts of district Hissar and Patiala State, 1907; 53-r, 12 and 16, parts of districts Saharanpur and Dehra Dun (U.P.), and Ambala (Punjab), 1907.—Sind Survey, scale 1 inch to 1 mile. Sheets 52, parts of districts Hyderabad and Karachi, 1907.—United Provinces Survey, scale 1 inch to 1 mile. Sheets: 53-k, 4 and 8, parts of districts Muzaffarnagar, Meerut, Bignor, and Moradabad, 1907; 54-m, 8 and 7, parts of districts Etah, Mainpuri, and Farukhabad, 1907; 63-n, 1 and 5, parts of districts Banda and Allahabad (U.P.), and Rewah, Sohawal, and Panna States (C.I. Agency), 1907; 63-n, 11 and 15, parts of districts Bahraich and Gonda, 1907; 63-j, 10 and 14, parts of districts Fyzabad and Basti, 1907.—United Provinces, district Farukhabad, scale 1 inch to 8 miles. Calcutta: Surveyor-General's Office, 1907. *Presented by the Secretary of State for India, through the India Office.*

India—North-West Frontier.

Topographical Section, General Staff.

North-Western Trans-Frontier: Mohmand Country. Scale 1:175,000 or 1 inch to 275 stat. miles. Reduced and printed at the Ordnance Survey Office, Southampton, for the Topographical Section, General Staff, from the Half-inch Sheets of the Survey of India, April, 1908. London: Topographical Section, General Staff, War Office, 1908. *Price 1s. Presented by the Director of Military Operations.*

AFRICA.

Cape Colony.

Cape Geological Commission.

Geological map of the Colony of the Cape of Good Hope. Scale 1:238,000 or 1 inch to 37 stat. miles. Sheets: XLII., XLVI., LII. Cape Town: Geological Commission, 1907-08. *Price 2s. 6d. each sheet. Presented by the Director, Geological Survey of the Cape of Good Hope.*

Sheet LII. shows the geological features of the country from Mafeking and from the Transvaal border westward, as far as the 24° E. longitude. XLII., and XLVI. which adjoins it to the north, show the geology of the district immediately to the west of the Orange River Colony and the Transvaal from Hopetown to a little to the north of Pokwain. In addition to Hopetown the former sheet includes Kimberley, while on the latter Barkly West and Warranton appear. A vertical section is given at the foot of each sheet.

Egypt.

Survey Department, Cairo.

Topographical Map of Egypt. Scale 1:50,000 or 1·3 inch to 1 stat. mile. Sheets: n.n. II.-I. s.w. X.-I., X.-II., XI.-I., XI.-II., XII.-I., XII.-II., XIII.-I., XIII.-II. Cairo: Survey Department, 1908. Presented by the Director-General, Survey Department, Cairo.

Egypt.

Survey Department, Cairo

Topographical Map of Egypt. Scale 1:10,000 or 6·3 inches to 1 stat. mile. Fayum Province. Sheets: s.w. 21-3, 21-4, 21-5, 21-7, 21-8, 22-4, 22-5, 22-6, 22-7, 22-8, 22-9, 23-4, 23-5, 23-6, 23-7, 23-8. Qalubia Province. Sheets: n.n. 7-4, 7-5, 7-6, 8-4, 8-5, 8-6, 9-5. Cairo: Survey Department, 1907-08. Presented by the Director-General, Survey Department, Cairo.

Gold Coast.

Guggisberg.

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.N., F.R.G.S., Director of Surveys, Gold Coast. Scale 1:125,000 or 1 inch to 1·9 stat. mile. Sheets: 72-K-II., Bompata; 73-M-II. and 73-N-I., Ada. Edinburgh and London: W. & A. K. Johnston, Ltd., 1908. Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.

The Ada sheet includes the country from the coast to 6° 0' N. lat., and from 0° 30' to 1° 3' E. long., and thus shows the lower course and mouth of the river Volta, which, by the way, is unnamed on the sheet. On the Bompata sheet the country from 6° 30' to 7° 5' N. lat. and from 1° 0' to 1° 30' W. is represented. The sheets are printed in colours conformably with the others of the same series, and contain the usual clear explanation of terms and symbols.

Morocco.

Gentil and Chesneau.

Itinéraires dans le Haut Atlas Marocain par Louis Gentil. Carte honorée d'une subvention du Département des Affaires Étrangères, dressée et dessinée avec la collaboration de Marius Chesneau. Scale 1:250,000 or 1 inch to 3·9 stat. miles. *La Géographie*, vol. 17, 1908, Pl. 2. Paris: Masson et Cie., 1908. Presented by M. Ch. Rabot.

M. Louis Gentil's routes and surveys extended along the coast-line from Mogador southward to near the mouth of the Draa, and in various directions inland to about 7° W. long. In addition to the topographical features along the lines of the routes followed, the geology of the country traversed is clearly shown by colour-tinting, and the map is most complete in the information it contains. An account of M. Gentil's explorations, accompanied by this map, is given in the Paris Geographical Society's publication *La Géographie* (1908, 15 Mars).

Southern Nigeria.

Survey Department, Lagos.

Map of the Western Province of the Colony and Protectorate of Southern Nigeria. Compiled at Survey Department, Lagos, 1907. Scale 1:250,000 or 1 inch to 3·9 stat. miles. Sheets: 73-D and part of C; 73-E; 73-J and part of I. London: Topographical Section, General Staff, War Office, 1908. Price 6d. each sheet. Presented by the Director of Military Operations.

These are preliminary editions, uncoloured, of three sheets of the Government Survey of Western Province of Southern Nigeria, including Lagos and the country to the north and north-east, as far as the parallel of 8° 5' N. Owing to dense forests and the thickly wooded nature of the country generally, a regular triangulation was found impracticable, and the map is therefore chiefly based upon a large number of carefully measured and adjusted traverses made either by Mr. E. P. Cotton, the Director of Surveys, himself, or under his direct supervision. What with clearing the ground, the running of the traverse lines, the astronomical observations, and the careful system of adjustment and computation, the work represented is far more than would be supposed by the outline appearance of the sheets. No attempt has been made to show heights, but these will be given upon later editions of the sheets, the present being only preliminary issues, published to meet pressing demands. A note states that in the final map the spelling of place-names will be made to conform to the rules of the Royal Geographical Society, although why this has not been done in the present instance is not explained. The scale of 1:250,000 has been adopted for publication, so that the sheets, although forming a separate map, can readily be embodied in the general map of Africa in course of preparation by the Topographical Section of the War Office.

Transvaal.

Transvaal Geological Survey.

Transvaal Geological Survey. Scale 1:150,000 or 1 inch to 2·4 stat. miles. Sheet

3, Middleburg. Pretoria: Mines Department,*Geological Survey, 1907. *Presented by the Transvaal Government.*

The area included in this sheet was geologically surveyed in 1903-6 by Mr. E. T. Mellor, B.Sc., F.G.S., with the exception of the north-west and south-west corners, which are from the work of Mr. A. L. Hall, B.A., F.G.S. A pamphlet accompanies the sheet, giving a description of the geology of the neighbourhood of Middleburg, and of the country westwards as far as Bronkhurst Spruit, by Mr. E. T. Mellor, for which Mr. H. Kynaston, B.A., F.G.S., the director of the survey, has written an introduction.

AMERICA.

Argentine Republic—Entre Rios. Departamento de Obras Públicas, Buenos Aires.

Carta de la Provincia de Entre Rios. Construida por el Departamento de Obras Públicas con los datos de su archivo. Scale 1:200,000 or 1 inch to 3·2 stat. miles.

8 sheets. Buenos Aires: Departamento de Obras Públicas. *Presented by the Argentine Ministry of Public Works, through W. S. Barclay, Esq.*

This is a good map, on a large scale, of the Province of Entre-Rios, constructed by the Department of Public Works of Argentina from surveys and all available documents in its archives. It is printed in colours, and gives as an inset an enlarged plan of Paraná, the capital of the province. A useful table of latitudes, longitudes, and heights will be found in the south-west corner of the map.

Argentine Republic—Rio Paraná. Ministerio de Obras Públicas, Buenos Aires.

Rio Paraná. Plano de Navegación. Scale 1:100,000 or 1 inch to 1·6 stat. mile.

7 sheets. Buenos Aires: Ministerio de Obras Públicas, 1901-1907. *Presented by the Argentine Ministry of Public Works through W. S. Barclay, Esq.*

These charts of the Rio Paraná, from recent surveys made under the direction of the department of Public Works of Argentina, have been presented to this Society by that department through the kindness of Mr. W. S. Barclay. Soundings, in feet, are shown along the navigation channel below the level of ordinary low water, in addition to which the general depth of the water above and below 19 feet is shown by two different tints of blue. Other information likely to be useful for navigation of the river is given, and altogether the charts are most creditable productions.

Bolivia.

Mesa.

Mapa general de la Republica de Bolivia. Por Luis Garcia Meza. Scale 1:2,500,000 or 1 inch to 39·5 stat. miles. Winterthur: A. G. Suiza, 1908.

AUSTRALASIA.

Dutch New Guinea.

Lorents.

H. A. Lorentz' Expedition nach dem südwestlichen Neu-Guinca, 1907. Scale 1:3,000,000 or 1 inch to 47·3 stat. miles. *Petermanns Mitteilungen, Jahrgang, 1908, Tafel 9.* Gotha: Justus Perthes, 1908. *Presented by the Publisher.*

INDIAN OCEAN.

Indian Ocean.

Dallas and Walker.

Meteorological Atlas of the Indian Seas and the North Indian Ocean. Prepared chiefly by W. L. Dallas, under the direction of Gilbert T. Walker, M.A., Sc. D., F.R.S., Director-General of Observatories. Simla: Meteorological Department of the Government of India, 1908. *Presented by the Director of Observatories, Simla.* Price, in India, R. 13; in the United Kingdom, 17s. 6d.

This atlas will be specially noticed in a subsequent number.

GENERAL.

World.

Benians and Knight.

Historical Atlas with chronological notes. By E. A. Benians, M.A., and T. H. Knight, M.A. The Oxford and Cambridge Edition. London: George Gill & Sons, Ltd., [1908]. Price 8d.

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published by the Hydrographic Department, Admiralty, during March, 1908. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
26 m =	$\begin{cases} 6\cdot2 \\ 18\cdot5 \end{cases}$	England, south coast, Tor bay. Plan:—Torquay harbour. 8s.
2568 m =	5·2	Orkney islands:—Hoy sound. 8s.

No.	Inches.		
3665 m =	0.24	Central Africa:—Victoria Nyanza, southern portion.	5s.
3686 m =	3.0	Ceylon:—Approaches to Colombo harbour.	3s.
2391 m =	{1.4 7.2}	Philippine islands:—Iloilo strait, part of Guimaras strait, Iloilo river.	3s.
3632 m =	5.9	China, south coast:—Wan chu chau (Stonecutters island) to Brothers point.	4s.
1080 m =	1.9	Tasmania, river Tamar:—Low head to Launceston.	3s.

New Plans and Plans added.

957 m =	3.7	Ports in the Philippine islands. Plan added:—Lanang.	2s.
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Charts Cancelled.

No.		Cancelled by	No.
26	England, south coast:—Tor bay, Torquay harbour.	New Chart.	
*2568	Scotland, north coast:—Hoy sound.	New chart.	
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N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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